Popular Science

MONTHLY Founded 1872

May
1927
25 cents

"FIRE-SHY"—A THRILLING STORY OF STEEL

Complete In This Issue

Constant pounding, plus shrinkage, loosens hammer handles

But you can tighten a PLUMB just by a turn of the screw

YOU'VE done it . . . reached for your hammer and found the head wobbled. Wasted your time trying to rewedge it.

But not with a Plumb! When a Plumb Handle loosens (as all handles do) just turn the screw and the head is tight again. (An exclusive Plumb feature.)

The husky Plumb Ball Pein is the hammer for heavy duty. The head is mounted off-center to give power to your blows.

The large eye takes a full-size handle which practically does away with breakage.

The pein is cone-shaped. (Not round.) It spreads rivets instead of mashing them.

For heavy blows, with little effort — for a tool that is always tight and safe —choose the Plumb Ball Pein. Look for the Red Handle and Black Head in hardware stores everywhere.

FAYETTE R. PLUMB, Inc.
Philadelphia, U. S. A.

Plumb Ball Pein

No. H F-373, weight 1 lb., price $1.15 (except in Far West and Canada). Heavier weights proportionately higher.

CADILLAC *welcomes*

La Salle

A New CAR *for* CADILLAC HOMES

Only within the past twenty-four months has it been possible for Cadillac to look beyond its own particular field and arrange to satisfy that other great market which has long demanded a companion-car of Cadillac's calibre to fill a slightly varying field of usefulness.

The congenial task of creating this other-brother to Cadillac has gone on carefully for nearly four years. It has proceeded with those inch-at-a-time precisions and precautions which exist only in the Cadillac engineering department and shops—supplemented by the facilities and the resources of the General Motors laboratories and proving grounds.

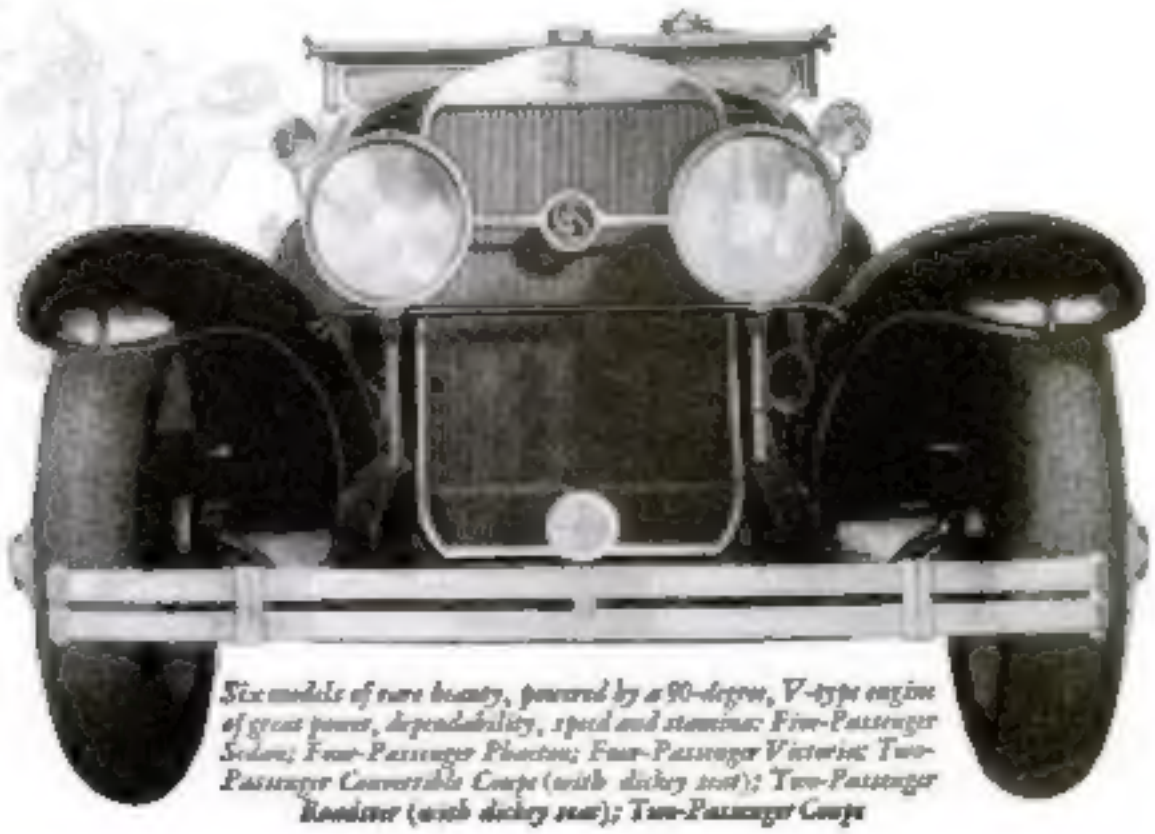
The luminous result is a rarely beautiful car of most brilliant performance—the LaSalle—companion-car in every sense of the word to the Cadillac as *Sieur Rene Robert Cavelier* LaSalle himself was companion in distinguished achievement to that other great early-American, *Sieur Antoine de la Mothe* Cadillac.

The LaSalle is manufactured completely by the Cadillac Motor Car Company within its own plant.

CADILLAC MOTOR CAR COMPANY

Detroit, Michigan • • Oshawa, Canada

Division of General Motors Corporation



Six models of rare beauty, powered by a 90-degree, V-type engine of great power, dependability, speed and stamina: Five-Passenger Sedan; Four-Passenger Phaeton; Four-Passenger Victoria; Two-Passenger Convertible Coupe (with dickey seat); Two-Passenger Roadster (with dickey seat); Two-Passenger Coupe

HE MOVED THE WORLD

A WEE boy, scarcely old enough to have accurate control of his hands, dumped a heavy load of sand from his toy truck. I marveled at the mechanism that enabled him to lift the weight. And yet, the ratchet that tilted the load was but an application of one of the oldest principles of mechanics—that of the lever.

Archimedes, in 231 B. C., laid down the law of the lever. He said that, given a strong enough lever and a fulcrum, he could move the world. An impossible experiment, of course, but the principles he expounded laid the foundation for modern mechanics which *have* moved the world.

The inventor of that toy truck merely adjusted his lever so that it turned a cogwheel which moved a toothed bar and raised the truck body.

REALLY new ideas are rare. Hero, of Alexandria in Egypt, had the idea for the steam engine 250 years before Christ. More than 2,000 years later James Watt put the idea to work. Adaptations of old ideas to new and useful purposes are more frequent—and frequently more valuable.

WHEELER McMILLEN, able investigator, points out in this issue how science can help solve the farm problem. Already many farmers are using electricity to light their homes, pump water, milk cows, wash clothes, sweep floors, make ice cream and run motion picture machines. Give every farmer, in electricity, a thousand more hands to do his work and triple his revenue by utilizing the wasted products of his crop and there will be no "farm problem."

COMMANDER RICHARD E. BYRD tells us of his wise preparation against disaster on the proposed flight across the Atlantic. A perilous trip, one few of us would willingly undertake. And yet, only ninety-eight years ago, the Liverpool and Manchester Railway paid people to ride on trains to demonstrate that they were safe. Commercial air conquest of the Atlantic is sure. England, Germany, France, Italy and the United States all are preparing for it. Accomplished, men will marvel a few days, then turn to some new wonder. Television or cold light, perhaps.

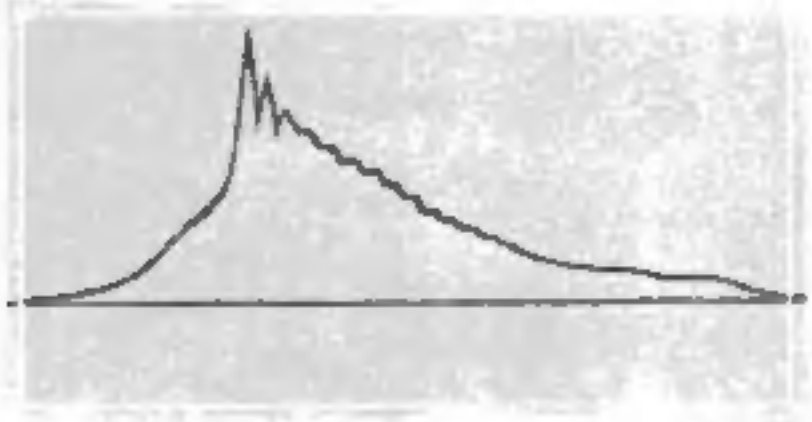
PHOTOGRAPHS of lightning have been taken at the rate of 2600 a second by J. W. Legg, of the Westinghouse Company. These demonstrate that a lightning flash is a series of complex, corkscrewlike spirals. This scientist's new twenty-two-lensed camera may tell us definitely what causes lightning, how to use it and to protect ourselves against it. Millions of horsepower going to waste in lightning, enough to do the work of the world!

DR. SAMUEL GELFAN, of the University of California, has discovered that a single human cell, stimulated by electricity, is rejuvenated. Electricity may some day, as a result, be used to repair worn-out organs of the human body. Paul Berlenbach, who became a boxing champion, was deaf and dumb until he was twelve. Shocked endeavoring to recover a kite caught in electric wires, he found speech and hearing. There's magic in electricity!

LIONS pass man-killing tendencies from one generation to another, says Captain C. R. S. Pitman elsewhere in this issue. Interesting—especially to those who believe that our traits can be passed on to our descendants by minute fragments of plasm called chromosomes. Experiments with animals constantly increase knowledge of heredity. Prof. M. F. Guyer, of the University of Wisconsin, demonstrated with rabbits the possibility of transmitting for five generations artificially induced resistance to typhoid fever. But we cannot know yet whether our children will have blue eyes or brown, be bright or dull. Go back only twenty generations and each of us has 2,097,150 direct ancestors. Any one of them may be responsible for our characteristics.—S. N. B.

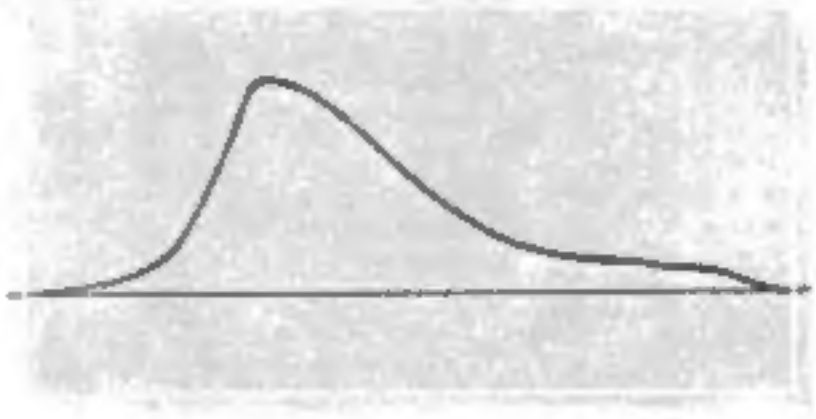
May, 1927, Vol. 110, No. 5. **Popular Science Monthly** is published monthly at 250 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3.

The first picture of that "knock"



This is the "knock" in your motor

This shows photographically what occurs in the engine cylinder as carbon forms, when straight gasoline is used. The increased heat and pressure created by the carbon cause the gasoline to explode too quickly, with the result that there is an accumulation of high pressure heat waves which strike against the cylinder walls so violently as to produce an audible metallic sound. The bumps in the line are that "knock."



This is how "ETHYL" knocks it out

And this shows photographically what goes on in the same cylinder under the same conditions when straight gasoline is treated with "ETHYL" fluid. Note the absence of "knock-bumps"; the evenness of the pressure changes. The "ETHYL" fluid has neutralized the heating qualities of the carbon deposits and by maintaining the normal combustion rate of gasoline has turned the increased pressure due to carbon into increased power.

THESE PHOTOGRAPHS were made possible by a special instrument invented by General Motors Research Laboratories to find out what goes on in an automobile engine's cylinder when "knocking" occurs.

That invention led to the discovery that what you may call an "engine knock" or a "spark knock" is in reality a *fuel knock*. It is due to the tendency of a straight gasoline to explode too quickly as carbon forms and increases temperature and compression (pressure).

Having determined the character of "knocking," General Motors developed "ETHYL" fluid, a patented chemical compound which when added in very small quantities to straight gasoline forms Ethyl Gasoline, the most effective "anti-knock" fuel yet known.

Ethyl Gasoline transforms carbon deposits from a liability into an asset. It produces more power on hills and heavy roads. It gives a faster "pick-up," reduces gear-shifting, lessens vibration and engine wear and tear; and saves the trouble and expense of carbon removal.

Ethyl Gasoline has increased the motoring satisfaction of hundreds of thousands of car drivers. It is destined to play a still more important part in the automobile history of the future. TRY IT.

ETHYL GASOLINE CORPORATION
25 Broadway, New York

ETHYL GASOLINE is now generally available throughout the United States and Canada through the following oil companies, licensed to mix "ETHYL" fluid with gasoline. The "ETHYL" trademark on the pump is your protection.

* * *

Associated Oil Company • Atlantic Refining Co. • Beacon Oil Company • Continental Oil Company • Humble Oil & Refining Co. • Imperial Oil Limited (Canada) • Pennzoil Company • Refiners Oil Company • Spears & Riddle Co. • Spokane Oil & Refining Co. • Standard Oil Company (Indiana) • Standard Oil Company (Kentucky) • Standard Oil Company of Louisiana • Standard Oil Co. (Neb.) • Standard Oil Company (N. J.) • Sterling Oil Company • Union Oil Company of California • Walburn Petroleum Co. • Waverly Oil Works

ETHYL GASOLINE

ETHYL — BRAND OF ANTI-KNOCK COMPOUND — ETHYL GASOLINE CORPORATION — Knocks out that "knock"

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

A REAL ABUSE TEST

So many people run their batteries up too high that, having made good Radiotrons for careful users, RCA set about to make Radiotrons that would stand abuse.

A year ago, an RCA Radiotron could stand about twenty hours of running under too heavy a current. Now it will outlive a hundred hours of such abuse.

Many very minute changes brought about through laboratory study have effected this improvement.

If you have children who are apt to turn up the rheostats carelessly, of course it is hard on the tubes. No tubes can be proof against ruin, but if you are using RCA Radiotrons, you know at least that they'll stand more than ordinary tubes.

Look for that RCA mark! You'll find it on Radiotrons for every purpose.

RADIO CORPORATION OF AMERICA
New York Chicago
San Francisco

The stations are there get them!

You're not getting the most out of that storage battery set of yours. The *set* has a bigger distance reach . . . all it needs is a different tube in the detector socket. Put in the RCA super-detector—Radiotron UX-200-A. You'll get more stations—get the far-away ones more regularly and more easily! It's a small change, but it brings big results.

• • • • • •

Bring your storage battery set up-to-date with
a *power* RADIOTRON UX-171 or UX-112
a *detector* RADIOTRON UX-200-A
and RADIOTRONS UX-201-A for all-round quality.
Bring your dry battery set up-to-date with
a *power* RADIOTRON UX-120
and RADIOTRONS UX-199 for all-round quality.

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The SERVANT PROBLEM Solved and a *Good Investment* Made

By WALLACE AMES, *Financial Editor*

MRS. TULLY seemed unusually well pleased with something as the family sat down to dinner one evening recently.

"What's up?" queried her husband, all filled with unmasculine-like curiosity.

"I've solved the servant problem," announced Mrs. Tully.

"The servant problem?" repeated the somewhat puzzled Mr. Tully. "Why, I thought that was solved when we moved into this apartment last October and turned most all the housework over to electricity. The electric stove, the electric vacuum cleaner, the electric washer, the toaster, percolator, waffle iron and I don't know how many other electrically operated things—weren't they supposed to solve the servant problem?"

"Well," explained Mrs. Tully, to satisfy her husband's curiosity, "all the electrical equipment we got last fall solved part of the servant problem, but not all of it. Electricity has made the housework so light that I am now getting along easier and happier without servants than I used to with them. But there is no denying that our electricity bills are larger. Now I have found a way to pay for the extra current our electrical servants use."

"You mean," said Mr. Tully, "that you have now solved the servant pay problem as well as the servant labor problem. That sounds interesting. How did you do it?"

"A MAN called today from the electric company and offered us an opportunity to invest in their preferred stock. It pays 7%. If we invest in 20 shares our dividends will amount to $140 a year. That is almost $12 a month and about the same as our electric bills are now running.

"My idea is to get some of this preferred stock and make our dividends pay our electricity bills. We are helping the company make money by using electricity. Now I propose that we turn around and get enough of those profits back to pay for the electricity we use.

"A lot of the things he told me about the stock I do not understand fully, but it seems to me that if other people are going in for the use of electricity the way we are, the stock of the company that is furnishing all the current ought to be a good, safe investment."

Unknowingly perhaps, Mrs. Tully had hit right at the heart of a basic investment principle. What she wanted to do was to invest in an *essential industry whose business is constantly increasing.*

A Service for Readers

THIS Financial Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it.

The Editor of this Department is an authority on investment matters. He is ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Address your inquiries to Wallace Ames, Financial Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

Public utility securities are becoming more and more popular as investments and are highly regarded in all well-informed circles. The bonds and shares of companies which serve communities with electric light and power, gas, street railway transportation, etc., are usually hedged about with situations and conditions which make them highly desirable investments.

Regulation by Public Service Commissions protect the investor as well as the general public. The circumstances under which securities may be issued present an element of safety. A definite amount of property value and of earnings must be established behind each new issue of stock or bonds.

While the utilities are restricted as to the charge they may make for service, they operate under franchises which limit or prevent the ravages of competition.

In the beginning utilities were independent and comparatively small. The later trend was toward consolidation and grouping into large organizations serving extensive territories. This arrangement has put the utilities in strong financial hands and has meant more economical and more skillful operating management for each individual company. It has resulted in better and broader service. Whereas in the beginning the uses of such a service as electricity were quite limited they are now very general and their future increase is only a matter of imagination.

Take electricity alone. It lights our streets, homes, stores, offices and factories, operates our advertising signs and traffic systems, turns factory wheels, runs mining machinery, office elevators and building construction machinery; it is our dependable home servant as it operates the washing machine, vacuum cleaner, refrigerator, oil burner, various cooking implements, electric fans, radios, etc.

NO CHANGE in fashion is going to render obsolete the use and need for electric current and other essential public utility services. On the other hand their uses will continue steadily, increasing in homes, business and industrial organizations.

Public utilities do a cash business; they have no credit risks. Unless bills are promptly paid service is suspended.

The customers or market for public utility service is broadly diversified. It is not dependent on a few big customers, or on any particular line of business. Its volume does not violently fluctuate with changing economic conditions. It has a multitude of comparatively small customers of all sorts. The loss of any customer or type of trade would easily be overcome.

Almost every utility now maintains an investment department and allows its customers to become shareholders. In addition to this, most of the leading investment bankers of the country deal in public utility securities, both preferred stock and bonds.

Whether or not the readers of POPULAR SCIENCE MONTHLY want to adopt Mrs. Tully's idea of paying electric servant hire with dividends, the securities of our leading public utility organizations are a sound and important addition to everyone's list of investments.

Booklets That Will Help You Get Ahead

ANYONE with money available for investments will find the booklets listed below of help in getting ahead financially. You may obtain any of these booklets by writing direct to the issuing house. It will be appreciated if you mention POPULAR SCIENCE MONTHLY when writing for booklets.

How to Build an Independent Income (1927 Edition)—Describes a plan for buying 6½% First Mortgage Bonds by payments of $10 or more a month, and shows the results that may be accomplished by systematic investment at 6½%. For copies address: The F. H. Smith Company, Smith Building, Washington, D. C. Ask for Booklet 75.

Why Your Real Estate Bonds Should Be Guaranteed is the self-explanatory title of a booklet on a subject of wide interest among investors in Real Estate bonds. Address: Adair Realty & Trust Co., Healey Building, Atlanta, Ga. Ask for Booklet P. S.-3.

Forty-four Years Without Loss to Any Investor presents the safety record of this house and describes the safeguards constituting the Straus Plan. Address: S. W. Straus & Co., Desk P, Fifth Avenue & 46th Street, New York, N. Y.

The Strength of the Utilities, with illustrations, charts and layman's language, presents facts that every investor should know regarding the public utility industry. Address: Halsey, Stuart & Co., 201 So. La Salle St., Chicago, Ill. Ask for Booklet P. S.-S. U.

The Making of a Good Investment explains the methods employed by the United States Mortgage Bond Co. in originating first mortgage bond issues which pay 6% with principal and interest guaranteed, or 6½% without the guarantee, which is optional with the investor. Address: United States Mortgage Bond Company, 365 U. S. Mortgage Bldg., Detroit, Mich.

An Investment Insured for Its Lifetime describes a plan of insured mortgage investments. Nine points of safety are explained. Address: Mortgage Security Company of America, Norfolk, Va.

Rules for Safe Investments explains in language that the layman can understand the important factors of safety of real estate bonds. Address: American Bond & Mortgage Company, 345 Madison Avenue, New York, N. Y., and ask for Booklet P. S.-40.

Buying Bonds by Mail explains how the investor may safely and conveniently deal with an investment banker through the mails, and without the usual advantage of direct contact. Address: A. C. Allyn & Co., 67 West Monroe Street, Chicago, Ill. Ask for Booklet D. E.-2430.

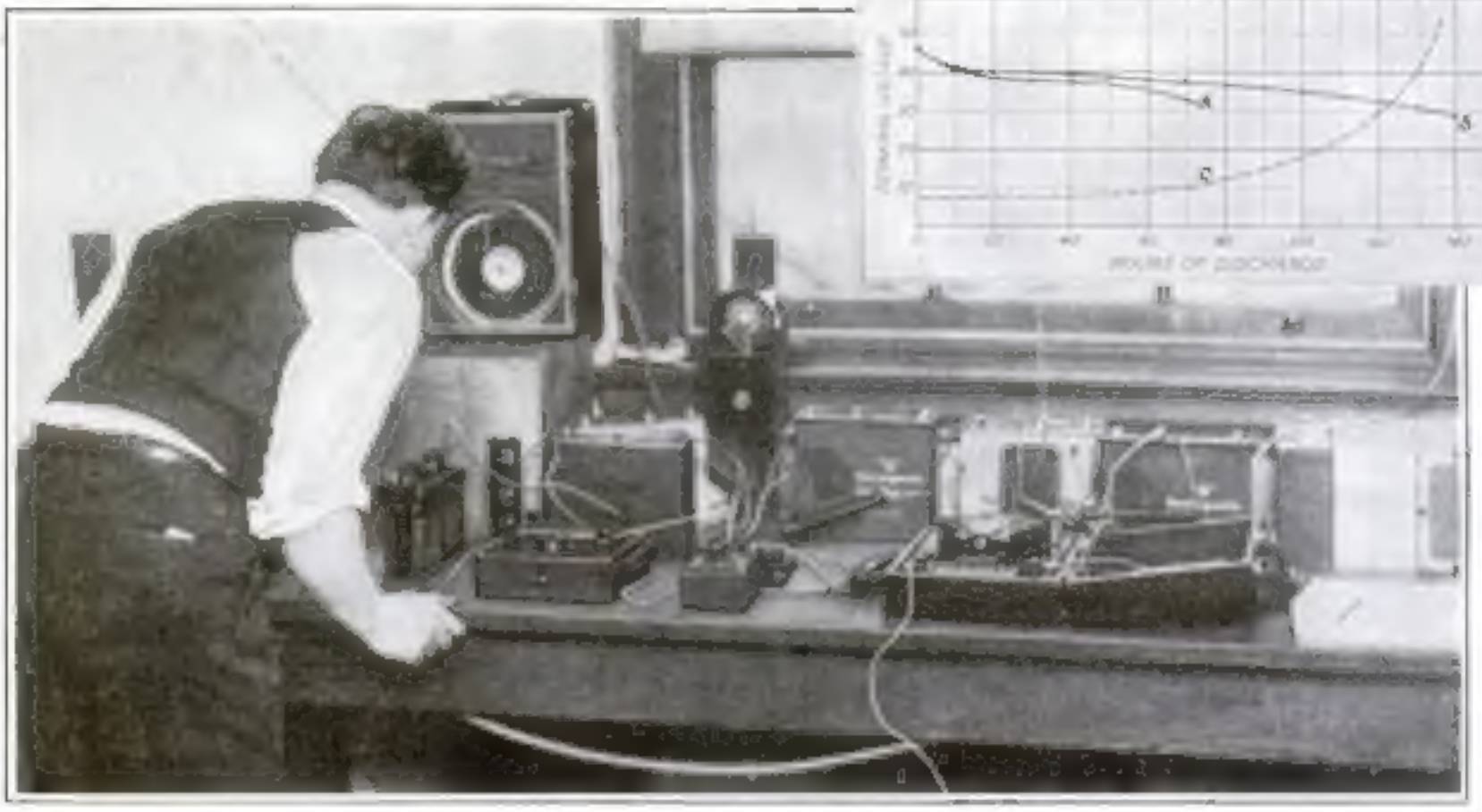
The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., Chemical Building, St. Louis, Mo., and ask for Booklet P.S.M.

Investment Service explains the service given by a first mortgage bond house. Address: Federal Bond & Mortgage Co., 1444 Griswold Street, Detroit, Mich.

The Science of Fortune Building, published by George M. Forman & Co., is the explanation of practical, tested plans employed by investors to attain financial independence. Address: George M. Forman & Co., 164 West Monroe St., Chicago, Ill. Ask for Booklet 833.

Investors' Guide, published by Greenebaum Sons Investment Company, combines a description of "bank safeguarded" bonds with an outline of the service of that company. Address: Greenebaum Sons Investment Co., 9 So. LaSalle St., Chicago, Ill.

By Alexander Senauke, E. E.
Assistant Director Popular Science Institute



Why You Need Good B-Batteries

FEW owners of radio sets attach sufficient importance to the source of vacuum tube plate supply that they use and the rôle that this plays in the radio outfit.

If they appreciated how much the proper operation of the receiver, its quality of reproduction and economy of operation depended on this very important radio accessory, they would take considerably more care in its selection.

The dry B-battery, due to the fact that it requires a minimum outlay, is most conveniently installed, and possesses operating characteristics that are ideal, is still the most popular type of vacuum tube plate supply.

To assure a maximum economy—that is, lowest cost per hour of operation—maximum satisfaction, maintained excellence of tonal reproduction and freedom from the necessity of frequent replacement, dry batteries should not be purchased on the basis of initial cost or apparent size, but should be bought by name and size as specified by the battery manufacturer or the manufacturer of the receiving set.

To guide the purchaser in this, the Popular Science Institute of Standards is regularly conducting tests on all sizes and types of dry batteries submitted to them by various manufacturers and purchased through legitimate dealers to make certain that the batteries of the manufacturers listed in the Institute's "Approved List" show a degree of excellence that is consistent with their list price and intended uses.

The Institute's tests on batteries determine the following:

1. Internal resistance when new.
2. Internal resistance under normal load, at various stages of discharge.
3. Discharge characteristic, for continuous discharge through 1,000 ohms per 22½-volt section.
4. Discharge characteristic, for intermittent discharge through 1,000 ohms per 22½-volt section.

The general procedure of test is as follows. The first measurements made on a new battery are usually its open circuit potential by a potentiometer or equivalent arrangement, and its internal resistance. One or more samples are then placed on the continuous discharge test and their behavior observed through the graphs of recording meters or regular readings of ordinary meters. The calculated milliampere-hour capacity from the graphical records of the continuous discharge characteristics, serves as a gage of the approximate relative lasting qualities of the battery.

Other samples are placed on the intermittent discharge test, and are connected to the load at pre-set intervals through special clock-activated switches. At regular intervals their change in terminal voltage is recorded, and their internal resistance measured. Also, periodically, their freedom from "noise producing" internal reactions are checked with especially arranged amplifiers. The results of these tests are plotted and serve as an absolute guide as to the merit of the battery.

IN ORDER to be approved by the Popular Science Institute of Standards, a battery in these tests must show (1) a sufficiently low internal resistance so as not to affect the operating characteristics of standard receivers, (2) absolute freedom from "noise producing" reactions during its normal life, (3) a total milliampere-hour capacity at the standard discharge rate, to indicate a probable useful life consistent with its type and price.

Readers can obtain the List of Approved Radio and Tool Products by writing the Popular Science Institute, 250 Fourth Ave., New York City.

The Textile Industry saves money by using *Tycos*-the Sixth Sense

AN ANNUAL saving of $22,000 a year is made by one textile manufacturer who installed *Tycos* Instruments. Not only is this manufacturer saving $22,000 a year but he also made possible a more uniform quality for his product.

Tycos Instruments for Indicating, Recording and Controlling heat and humidity in the textile industry not only are saving money for textile manufacturers but, because they work automatically, eliminate guesswork and inaccuracy.

Whether you use heat in your manufacturing processes—whether for making silk or cotton goods, armor-plate or baking enamel on cuff buttons, for making rubber tires or hatching eggs or making paints, metalware, furniture or any other product that goes through heat treating processes—you need in your plant *Tycos* Instruments for Indicating, Recording and Controlling Temperatures.

Tycos Engineers have effected substantial economy for manufacturers in every line of industry by applying the *Tycos* "Sixth Sense." Whatever your needs in the indicating, recording or controlling of heat, there is a *Tycos* Instrument to serve you. Write us for literature on any instrument, or type of instrument, and it will be sent promptly. Or, if you prefer, our engineers will consult with you on the application of the *Tycos* Sixth Sense in your plant.

Tycos for the Home

***Tycos** Oven Thermometers*
An aid to promoting culinary efficiency.

***Tycos** Bath Thermometers*
To enable you to get the most good from your bath.

***Tycos** Home Set*
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

***Tycos** Wall Thermometers*
To help you maintain a temperature in your house conducive to good health.

***Tycos** Quality Companion*
To show you the right way in unfamiliar country.

***Tycos** Fever Thermometers*
A necessity in every home.

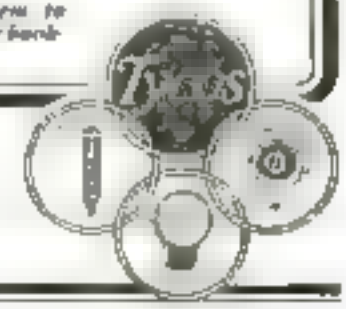
***Tycos** Stormoguide*
Forecasts the weather twenty-four hours ahead with dependable accuracy.

***Tycos** Hygrometer*
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Tycos for the Medical Profession

***Tycos** Sphygmomanometer*—Pocket and Office types.
***Tycos** Urinalysis Glassware*
***Tycos** Fever Thermometers*

Your dealer will show them to you. Ask us, on a postcard, for booklets on any of the above.



Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. · · U.S.A.
Canadian Plant—BUILDING TORONTO
SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain

THE ~ SIXTH ~ SENSE ~ OF ~ INDUSTRY

Tycos Temperature Instruments

INDICATING · RECORDING · CONTROLLING

Popular Science MONTHLY

VOLUME 110 SUMNER N BLOSSOM *Editor* NUMBER 5

New Wealth *from* Farm Waste

Shoes from Cornstalks, Paint from Straw and Other By-Products May Save Us Millions

By WHEELER McMILLEN

"WE ARE only skimming the cream of our potential national wealth," says Mr. McMillen. ¶ "We have learned to take perfumes, dyes and other values out of coal tar. ¶ We have learned to crack petroleum and get twice as much gasoline. ¶ Now the alchemists of science are putting into retorts straw, peanut shells and cornstalks. ¶ As a result we already have new ways of making mucilage, guncotton, pipe stems and shoe polish. ¶ And we are promised a host of other new marvels."

YOU who pay grocery bills and the farmer who grows the groceries may peer hopefully these days into scientific laboratories. There effective methods of accomplishing that seemingly impossible feat—cutting the costs of food while simultaneously increasing the prices of farm products—are being found.

Astonishingly little of the enormous volume of production on the 6,500,000 farms in the United States yields any profit to the farmer or is of actual use to anyone. The average acre of wheat yields 900 pounds of grain and 4,000 pounds of straw. Commercially, the straw is waste—two tons that serve no purpose except to go back to the soil. Less than half a ton of the acre's entire wheat production is actually utilized.

Yet a Minnesota chemist has recovered from a ton of straw 1000 pounds of useful products worth at present market prices around $2501. Immeasurable wealth for the farmer and the rest of us is available in agricultural waste.

AS SCIENTISTS succeed in their task of reclaiming this waste, more and more commodities will move into trade and more and more money will go back to the farmers. More food, at lower prices, will be available and farmers will make more money from their by-products than from their food products.

Lignin found in straw, stalks and most plant refuse, according to Dr. C. A. Browne, chief of the Bureau of Chemistry in the Department of Agriculture, "probably offers as many methods of utilization for the manufacture of tanning materials, dyestuffs, and other industrial products as was offered eighty years ago by that other trade waste, coal tar, which has proved to be an almost inexhaustible source of wealth."

CELLULOSE, which makes up the chief part of the solid framework of plants, has innumerable uses, and few of the sources of it, besides wood pulp, have been utilized. Efforts are being made now to utilize cornstalks for paper making.

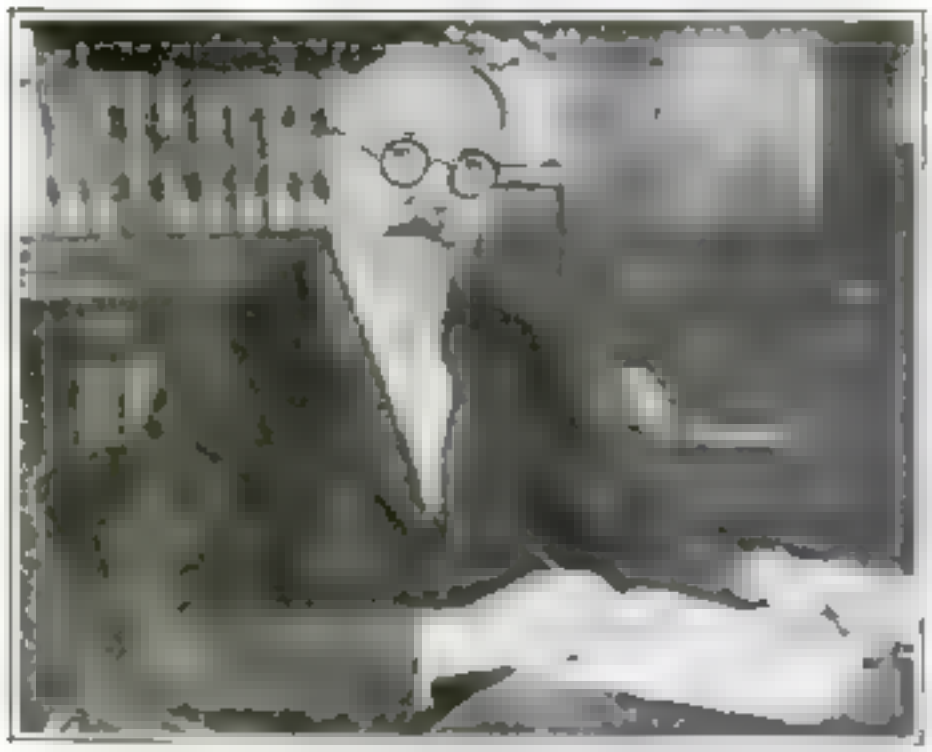
Congress has appropriated $50,000 with which the Bureau of Standards will begin July 1 investigation into uses of peanut shells and corn and cotton stalks.

Already the United States Department of Agriculture has issued a list of 217 products and uses of corn. Most of these are derived only from the grain of the corn, of which some three billion bushels are harvested annually in the United States. And the grain represents only about one fourth of the total weight of the corn plant, nearly all of which at the present time goes to waste.

Aside from its food uses, corn goes into the manufacture of mucilage, guncotton, talcum powder, shoe polish, printer's ink, leather, textiles, the fireworks called "sparklers," rubber substitutes, and so on for a long and surprising list. Your red rubber bath sponge is probably made of corn. By a vulcanizing process applied to corn oil, the rubber substitutes are derived, though rubber of high tensile strength has not been produced from corn.

Furfural, a chemical important in making synthetic resin, can be derived from corncobs, although oat hulls, another farm waste, are used more extensively for commercial production of furfural. Phonograph records, pipestems and cigarette holders, telephone receivers and radio horns may all be the product of corncobs or oat hulls by the furfural route. Our yearly production of corncobs is twenty million tons. And nearly all are thrown away or burned.

MORE than a hundred million acres of the best American farm lands are devoted annually to the corn plant. A great stalk grows up from every grain that sprouts. Stalk, tassel, leaves, silks, cobs are wasted—only the seed is used. Moreover, about five sixths of all the grain itself is fed to animals, a procedure that one distin-



Dr C. A. Browne, chief of the Bureau of Chemistry, Department of Agriculture, who points out that millions are lost annually in straw cereals and other crop waste

and fermentable wastes, as of fruit; but until gasoline rises to about forty cents a gallon, petroleum will be a cheaper source of fuel for internal combustion engines. Most of this kind of alcohol now made in the United States is derived from blackstrap molasses, which is imported very cheaply from tropical countries.

George H Harrison is the Minnesota chemist who has taken $250 worth of products from a ton of straw by distillation He has even run his automobile engine with gas which was distilled from straw, and has the body of the car gleaming with paint made from straw. He leaves fine-chopped straw through tubes heated to 1200 degrees Fahrenheit, using a third of the gas thus produced from the straw to maintain the temperature. From each ton there remain 12 000 cubic feet of gas, which is piped to a condensing room where the separation processes yield 640 pounds of carbon, 400 pounds of pitch and fifteen gallons of straw oil

"Yet," says Harrison, "if you touch a match to a ton of straw all you have left is about forty pounds of ashes. I get most of these products from the part that would go off in the smoke."

STRAW oil may have an important future as a germicide and disinfectant. After experiments in a famous Minnesota hospital, it is reported to be a stronger disinfectant than phenol, which comes from coal tar, and to have the advantage of being nonirritant, neither destroying nor burning living tissues Waterproofing materials can be made from the pitch, and the carbon is being ground into high quality paints which are made on a continuous scale

No one has yet suggested distilling the family cow and using part of her to pull the automobile but her useful ness does not end with supplying milk and butter and cheese for the table Many a chemist comes in contact with her products before he sits down to the breakfast table. He can comb his hair and button his shirt with milk products, and may also use a horn made of milk. If he happens to be late for breakfast, it may be because he lingered too long the night before at a table where a game was played with red, white and blue chips made of milk. For combs and buttons, poker chips and billiard balls are commonly made from casein, a product of skim milk.

The cow even contributes to the magazines, for great quantities of casein are required to impart a smooth finish to printing papers, and the washable paints for walls and woodwork are made possible

A vivid picture of agricultural waste. This train of drawn corn pulls rides down all the stalks. Paper lumber substitutes, embalming fluids are only a few of the useful products being ground down under its wheels

gas-shield chemical products would be passed some day with the wasteful process of feeding raw bituminous coal to a furnace for heat supply.

Another noted chemist, Dr O. R Sweeney of Iowa State College, says, "I believe firmly that there is more cash value in the elaborated stalk and cob than there is in the corn. The uses to which we propose to put the by-products are extensive They include adhesive, paper, charcoal, fuel, solvents, embalming fluids chemicals and lumber substitute. Pipes, gas scrubbing material, furfural, charcoal, have already been produced."

One wag who saw Dr. Sweeney's statement exclaimed, "They already make embalming fluid out of corn!" Which leads to the more sober statement that in two former distilleries, one at Terre Haute and another in Peoria, 18,000 bushels of shelled corn are being consumed daily in the manufacture of the solvents butyl alcohol, acetone and ethyl alcohol. These fermentation products are used chiefly in the making of lacquer, dyes, artificial leathers and perfumes.

PRACTICALLY all the bagasse of the southern sugar mills is now made into an excellent lumber substitute. Investigations are being conducted in Iowa on the gathering of cornstalks for wallboard and paper making, for which the chemical processes are already well established.

Dr. E. B. Fred, head of the department of agricultural bacteriology in the University of Wisconsin, says that "perhaps lacquers prepared in this way will entirely replace our common paints." Dr. Fred's researches contributed certain important steps that led to use of corn in the solvent industry. "Let the bacteria do the work," he says.

Fuel alcohol for power use has long been chemically possible, and may eventually consume vast quantities of corn, potatoes,

The amazing straw product plant of G. H. Harrison, Minnesota, where from every ton of straw "waste" chemical magic recovers 15 gallons of oil, 640 pounds of carbon and 400 pounds of pitch

by the utilization of casein as a binder.

Among the huge wastes awaiting scientific attention is cheese whey. Three billion pounds a year of cheese whey not only lack a satisfactory use, but present a problem to the factories in sanitary disposal. Bacteriologists suggest that fermentation processes can be devised to turn this into organic solvents, such as butyl alcohol, acetone and lactic acid. Small amounts of whey and skim milk are now transformed into milk sugar. Dairymen are demanding cheaper processes for extracting the five percent of sugar that is in milk.

MILK sugar is preferred for coating pills, and is in small demand for infant feeding and a few other purposes. The most amazing development in the sugars is that promised by new discoveries by Dr. Frederick Bates and associates in the Bureau of Standards. This is the extraction of levulose, usually called "fruit sugar," from the tuberous roots of the Jerusalem artichoke. We in the United States are now dependent upon foreign sources for eight of the ten billion pounds of sugar we use annually. It is entirely possible that this may cease to be true. Artichokes will grow abundantly in practically every part of the country, doing well on many soils that are not highly fertile. The levulose extracted at the Bureau of Standards is about seventy-five percent sweeter than sucrose, as ordinary cane and beet sugar is called.

But the prospect for emancipating our sweet tooth from foreign producers depends not alone upon levulose. Processes proved in the laboratory have been adopted commercially for the manufacture of another kind of sugar, dextrose from corn. Corn sugar is used in ice cream, confectionary, bread, and for other purposes where too great sweetness is not desired. If levulose comes to be manufactured extensively, a sugar of standard sweetness may be marketed by mixing it with corn sugar.

THE Jerusalem artichoke is not the only new crop that may help solve the agricultural problem by substituting for crops whose over-production has depressed farm prices. The soy bean, imported some years ago from the Orient, is now grown here by the thousands of acres and from it we are deriving hay, stock feed, ivory substitutes and oil for paints.

Science is meeting and conquering another great source of wastefulness—the waste of millions of hours of human labor and of horsepower applied every crop-year to land that yields but indifferent returns because of deficiency in nitrogen.

Could nitrogen be supplied at low enough cost, the agricultural output from land now under cultivation would be increased enormously. All the interest that farmers have shown in the Government's disposal of the Muscle Shoals power plants has been centered in the possible use of that power for extraction of nitrogen from the air by electrical processes.

The new German process, using coal instead of electric power, also is attracting widespread attention. The tremendous significance of that discovery has only begun to penetrate. Within three or four years, probably, the process will be available for use in this country. Last year Germany exported more nitrogen than the farmers of the United States used. Announcement has recently been made of plans for construction of a synthetic nitrogen plant at Hopewell, Va.

The extraordinary import of the imminence of low-priced nitrogenous fertilizers lies in the fact that by their use production per acre can be very much increased at little additional labor expense. Therefore, although the total volume of crop production may so increase as to depress prices, the lowered cost of that production is likely to leave to the farmer a greater profit margin.

The meat packing industry's complete utilization of every part of every animal is perhaps the best known example of what can be done when science and business combine to eliminate waste. It is true that in many cases the carcass of an animal is sold in the meat shop for less than the packer paid the farmer for the live creature. The packer's operating expenses and profits can be covered by the absolutely complete utilization of the by-products. But for the by-products, farmers would be far more poorly paid for their livestock, and the meat dealer's prices would be far higher. No other agricultural products as yet are so thoroughly conserved.

BY FAR our greatest resource is the soil. We have nearly a billion acres (975,000,000) capable of being used for crops or pasture. As long as we put a hundred million acres in corn and use only the seed part of the plant, as long as we put fifty million acres in wheat and use only the grain, with the waste of other crops in proportion, we are only skimming the cream of our potential national wealth.

A few of the two hundred and seventeen devices and uses that the chemist's magic is extracting from corn and its hitherto wasted by-products, cornstalks and the lowly cob

Fire Shy

A flaming story of the men who tame rivers of steel - How one of them seared the craven fear from his soul

By EDMUND M. LITTELL

Author of "Midge"

Illustrated by H. T Fuk

CHUCK SELLERS might look like a real steel man the letter that introduced him might in so many words say that he could do a thing very few men had ever done, but—Pat Donnell, the black-eyed giant who ruled the open hearth furnaces of Argo Steel, looked from the man to the letter with an eye that saw behind the words.

"To whom it may concern

This will introduce Chuck Sellers who has been first helping for me for a year. He has never lost a heat.

Wm A Sims,
O H Supt.,
Monarch Steel Co.'

"Never lost a heat." Something should have been added to that. If it were true, Bill Sims, one of the best open hearth supers in the steel business, would never have let him go. Not unless there was a mighty good reason for it. Pat Donnell knew that. He raised his eyes for another keen scrutiny of the man who stood before him.

Six feet of muscle with the shoulders of a shovel wielder—and the hands of a man who hadn't worked at it for some time. A pair of blue eyes widely spaced and level—with dark rings beneath them. The long jaw of a fighter—with lips tightly closed and drawn lines about the mouth.

Pat Donnell needed first helpers, needed them badly. He had lost three in the past month, and first helpers are not to be found hanging on every lamp-post. One of his men had gone to Florida; one had taken his wife to Arizona, one—poor Tom—had ignored the ponderous advance of the friendly charging machine and been buried the same day. It had meant the promotion of three men who were not quite ready for it. It had called for more than the usual amount of work from his three melters. They had enough to do supervising the four furnaces each was responsible for; the necessity of practically working one of them was almost too much. And Pat—oh, well, he was used to doing the work of five men anyway, it wasn't hard to do a little more.

"Never lost a heat." That might be true, but this Chuck Sellers had lost something else, if Pat was any judge, and Pat knew men. He had seen their souls blistered raw in the heat from open hearth furnaces. He had seen the sores heal up, too. Sometimes. Heat does strange things, and when heat and bone-wearying labor go together—Chuck was standing the gaff of a silent inspection like a man, anyway.

"First helper, eh?" Pat's voice had the booming quality, even in this private conference at one end of the quarter-mile charging floor, of a man who could put men through their paces. "The only first helpers we got on this floor work their way up right here. I'd oughta put ya on the cinder pit."

A dirty, nasty job, the cinder pit. Take a pick and shovel, and shoes with two-inch soles, and climb down into the nest where the ladle sits below the tapping spout of the furnace. Dig out the hot, fuming mess of slag that boils over the rim after the hundred tons of molten steel has plunged down into it and it has been hoisted away. It's the meanest job on the open hearth. Pat's eyes glinted like a microscope lens as they watched the applicant's reaction.

CHUCK'S lips tightened a trifle more, his eyes wavered, then, clenching his hands, he accepted the challenge.

"All right," he said.

"But I don't need no third helpers." Pat spoke as though he had neither observed nor heard. More like a man thinking out loud. "Need second helpers, though."

"All right." The same tone. Humble, yet with a certain courage in it.

"Got anything to tell me?" Pat shot the question suddenly.

The blue eyes withstood his glance for a long moment. At first there was something of a determination in them, as though he would spill the thing that drew those lines on his face; then the light faded and he looked away, down the long floor that seemed to meet the brooding roof in the far distance.

"No," said he.

It was Pat's turn to look down the floor. But he did not see the piles of steel-making materials that littered its boulevard width, nor the long fronts of the twelve furnaces that walled its inner side and shot malicious gleams of light through their peephole eyes; he was thinking that Chuck Sellers had

A sizzling slosh of metal rose over the brim, struck the floor behind him, dripped on his hands. Chuck his arched back straining, clung to the heavy bar—and waited

a good deal of something to tell—when he was ready to talk.

"If mine!" A rumble that echoed deep in his chest. "Go to work right away?"

"Where?" With the look of anxiety displaced by one of eagerness.

"Number Five furnace."

PAT led the way down the outer edge of the floor. Nearly halfway back a blast of light was sweeping out, sun-strong, from the open doors of Number Five. It spot-lighted the activities of a crew of men that circled about in front of it with swinging shovels. Pat stopped beside a high-backed wooden bench that, with a steel water tank and three lockers, constituted the eating place for the crew of Number Five, and indicated a vacant locker.

Chuck knew what to do. He produced a pair of blue glasses from his pocket, set them firmly far out on his nose, and stripped to the waist. There were white marks on his shoulders and back, the scars that marked the former nestling places of white-hot slag. He picked up a shovel, hefted it for balance, frowned a little as though not quite pleased with it, and went out on to the floor to take his place in the rotating parade of men. They were making bottom. A sprawling pile of dolomite, white chalklike pebbles of roasted limestone and magnesia, lay between the widespread rails of the charging machine tracks before the yawning doors of a furnace that had just vomited its man-made lava and gaped meanderently for another heat. Its bottom, dotted with pockmarks eaten out by the departed steel, needed patching. Eighty feet long, that bottom, and twenty feet wide. Shallow, like a pan with sloping sides, and soaked throughout with two thousand degrees of heat.

Three crews were working at the job: men from Number Four and Number Six helping those on Number Five, and expecting a return of the compliment on their own furnaces later on. Nine men now that Chuck had joined them, circled from the dolomite pile to the furnace doors. Blue glasses were set far out on their noses for protection from the dazzle when shoveling at a pockmark and for ready looking around when their backs were turned upon the furnace. Arms were ridged with muscles, backs, chests and faces were wet with sweat that made them look gilded in the blast of light. A labor to test the strength of any man.

Chuck acted like a steel man. He swung his shovel like an artist. His slim waist was whalebone, his legs were rawhide, his arms and shoulders cabled with steel. He sweat, too. Pat disliked men who stayed dry. They generally blew up inside. So far so good. Pat turned away and looked up Pod Horton.

"New man on Number Five. Chuck Sellers, second helper. Watch him."

POD HORTON, one of those men who, laboring in the heat of ten Saharas and sweating rivers, grew fat on it, nodded silently. He had earned a melter's job long before, was entirely too busy bossing four furnaces to have to swing a shovel himself, and welcomed the addition that would relieve him.

"Bill Sims says he's a first helper, but we'll see," Pat added.

"We need 'em," said Pod, with an eye on the circling group.

"Not till we know 'em," said Pat, and hurried away to make up for the time lost in an interview.

It was late that afternoon that Pat became better acquainted with Chuck Sellers. Pat was on the opposite side of the great building, standing on a narrow shelf that clung, two

man-heights above the ground, to the towering wall. A hundred feet away from him across the dirt floor, Number Five was tapping a heat. All the other furnaces were inactive—on this side. But a river of fire was pouring out of Number Five's tap hole. It burst through at the center of the second floor level, sizzled down a clay-lined spout, and cascaded with a billow of smoke and flame into the room-size ladle that squatted in its cinder pit twenty feet below.

A BALCONY of steel sloped down to the tapping spout from either side. Flights of steel stairs, an extension of the passageway between the furnaces, dropped to the ground from the top of each slope. On the balcony, like a devil serving his river from hell, stood Chuck. He was heaving fifty-pound sacks of coal dust into the stream, recarburizing the heat, tossing them as though they were feathers, and making them strike precisely where the cataract struck the pool inside the ladle. He knew how. Beside him was Jerry Cox, shoveling the heavy manganese into the ladle. A promising youngster, Jerry Cox. Nearly as tall as Chuck, but not so heavy and some years younger. One of the brightest fellows on the floor, though. He was on trial as first helper now, and worked with a zest that reiterated his determination to make the promotion stick. He and Chuck ought to make a good team—if nothing goes wrong.

It did. One of those things happened that even Pat, with all his leaning back and forth in keen-eyed watchfulness, could not entirely prevent. The ladle was almost filled. The scum of slag was rising like a yeasty dough above the rim of the ladle, beginning to slop over and fill the cinder pit. There was a blubbery p-floop!! and a shower of sparklets rose slowly into the air and fell like rain—a puff.

When a ladle is relined with fire brick and smeared with clay it has to be thoroughly dried out. If it isn't, the contact of the liquid fire with the wet clay will generate steam. And steam has to escape, so it puffs out through the slag.

Those drops of slag are anything but rose petals when they light upon shoulders, even when a coat covers them. Chuck got some, and so did Jerry. Chuck had a few more sacks to heave, but Jerry was free to run. But he didn't. Instead, Chuck fled. Forgot his duty, his sacks, everything but that rain from hell. He tore up the slope of the balcony, around the corner of the furnace, and disappeared through the archway between it and its neighbor. Probably to throw himself into the water tank on the far side of the charging floor. He was fire shy!

NOT Jerry. He shook himself, dropped his shovel and finished recarburizing that heat. Pat knew how slag could nestle through clothing and eat at a man's hide; his shoulders itched with sympathy even while he swore softly in praise of the youngster. And, when the last sack had been tossed and the last drop of steel had dripped from the spout, he calmly waved a go-ahead signal to the operator of the crane that bridged the wide floor and was hooked on to the ladle. Even then he stood for a moment watching the massive bucket rise slowly out of its pit and start across to the waiting train of ingot molds before he followed Chuck. Then, if disgust was ever written upon a man, it showed in the swing of his shoulders.

Pat forgot that he had come to watch the teeming of this heat. Pouring steel into molds was secondary to what might take place over there. He jumped to the ground, though there were stairs not ten feet away, ran across to the steep flight leading to the balcony, thence to the charging floor. He found a fight in full swing with an audience eagerly forming.

"Cut it out, ya scuts!" he bellowed, and charged into the melee.

Chuck, dripping wet from a bath in the tank, he grabbed with one mighty hand; Jerry, still dry, with the other. Even those angered men had to surrender to such compulsion. Jerry did it willingly, with contempt glaring from his eyes. Chuck—his chin trembled and he cursed insanely—trying to reach the other.

"Called me a yella dog!" he jibbered. "The——"

"Well?" roared Pat. He might just as well have added "Not ya?" Chuck collapsed.

"Back to yer furnaces, ya cinder-hoppin' hounds!" Pat bellowed at the ring of men, and it dissolved, whispering.

"Pat take the furnace an' you two terriers, come with me."

Pat strode ahead of them to his tiny little office that crouched at the corner of the floor opposite Number One furnace. He was seldom in this cubby-hole, this man who had men and tonnage to handle; but there, with a door closed behind them, was the place to hear the something that Chuck had to tell. And Jerry, the man who condemned him, was the only other one qualified to listen in.

"Now," growled Pat. "Spill it."

"I ain't a yella dog," snarled Chuck. "I——I ain't a yella dog!"

PAT'S years on the heat ridden floor of Argo Steel had disclosed to him the naked emotions of many men. He had seen death, and the reactions it brought forth, hate, fear, rage, had stalked before him. But—it is a terrible thing to hear and see a grown man cry. It banishes anger like a mist before the sun. It stirs up sorrow, and pity, and—embarrassment. Pat turned his back on the heaving shoulders that bowed over his desk; Jerry stared dumbly out of the window. They waited with what indifference they could summon for the storm to blow itself out. At last, interrupted from time to time by a diminishing recurrence of gulps and nose blowings, the tale came out.

Chuck Sellers had slogged away at steel for more than six years before steel got him. And then it didn't get him, it got his brother. He had gone through those catastrophes that happen in a place of fires and melted elements without a quiver, had seen the terrible things that happen to men when steel breaks loose. He had his burns—he ripped off an coat and shirt to show them—burns taken with honor, as Jerry's were. Then he had brought his brother into the mill with him, and steel got him. Transfixed with horror, he had stood and seen his brother dissolved in steel while other men risked their lives. They forgave him that, tried to help him forget; but later, when he went through a puff just like this one, he had turned craven. He had fled that mill, tried another—and the men had ostracized him when it showed up again. He had quit steel, gone into other work but he "couldn't sleep with himself."

BILL SIMS, the man who had written that letter, was the last one who had tried to help him and his—not cowardice, but something—had beaten him once more. He had not told Pat about it because he hoped that he could whip it this time. Now—silence, his head on his arms.

"I got to whip it," came his muffled voice at last. "I got to!"

Chuck had his burns—he ripped off his coat and shirt to show them—burns taken with honor

Sock! It was Chuck's fist that landed, as he thrust Jerry aside Bony went sprawling

steel-and-man mixer, did something that was entirely different.

"Not if I know it!" he snorted with a great assumption of anger. "I'll have no fightin' on this floor, ya shovel-slingin' lizards!" He brought his mighty fist down with a crash on the desk that Chuck was using for a pillow—and Chuck straightened up with eyes that for all their redness had a grateful light in them. "Git back to yer furnace, ya got a bottom to make. An' no more shenanigans, get me?" He stormed to the door, grabbed its knob and jerked it open. "You birds make steel or get out, hear me?" He flashed a hot-eyed look at them and did not miss a grin of understanding from Jerry. "Git some salve on them burns," he added, and the door slammed upon them with a bang.

It was Pod Horton, directing the work of substitutes on Number Five, who told him a few minutes later what he already suspected. "A blame good steel man," he said. "Him an' steel go together like that." He held up a hand with two fingers in close parallel. "What's this about duckin' a puff?"

"NOTHIN' to it. Tell 'em Jerry sent him back. An' if they start laughin', tell 'em I said so," he added.

Pod nodded, without smiling. "He'll make a good first helper," was his reply.

"After a bit," said Pat, and went on to raise a little Cain with the foreman of the ladle-lining gang.

Chuck and Jerry appeared soon thereafter and took up their task of making bottom as though nothing had happened. There is no time for talk during that soul-trying labor, so if the men had any opinions they kept them to themselves. It was not until the next day that the floor expressed itself.

It took the form of a casual visit from Bony Carr, the eagle-beaked rack of skin and bones that was first helper on Number Three. He strolled over to where Chuck and Jerry were sprawling on their bench and volunteered the opinion that it looked like rain. Chuck flushed, then whitened, but gathered his feet under him. Jerry lifted a pair of hot eyes to the visitor and spoke first.

"NAW," he drawled, "but there's liable to be a stroke o' lightnin' any minute."

Bony was positively foolhardy. "Not before a little puff," he said.

Sock! It was Chuck's fist that landed, for he thrust Jerry aside with one hand and availed himself of the privilege with the other. Bony went sprawling.

"That's my job," said Chuck to Jerry. "You lay off."

"You can't have all the fun," was Jerry's retort as they watched Bony get to his feet.

And Bony, before he turned back to his furnace, signified that opinion would remain unchanged. "It's goin' to be mighty cloudy around here just the same."

That story followed the other two up and down the floor. The three in combination caused a good deal of confusion, for they could not understand Pat's outright lie in defense of a man who had positively fled from a puff. Nor could they raise the fire shy man either. Not only was it against Pat's expressed wishes [illegible] but it was quite evident that Chuck was most emphatically not man shy. They could treat Chuck as though he did not exist. I were left by the whisperings of Bony. What was, after all, far worse than razzing. And Jerry, who had the privilege of making his own choice in the matter, preferred to associate with Chuck.

Bottom making, charging, tapping and bottom making again. The days were filled in a monotonous round of labor and heat. The only talk that went on at Number Five was the dialogue between Chuck and Jerry, the only visitors they had beside Pat and Pod, whose many duties prevented anything but the briefest of chats, were the unspeakable machines that lingered only long enough to do their chores.

The train of low flat cars, bearing loaded charging boxes, that was spotted on the narrow-gage tracks close before the furnace by the pot-hooked donkey engine, the lumbering charging machine, like a fifteen-foot sawhorse of steel with a mass of machinery hanging between its legs, that trundled up on its twenty-foot tracks beside the train and emptied those charging boxes one by one in the glowing maw of the furnace; the cranes that stopped to dump great trays of dolomite or ferro on the floor between the charging machine tracks as fast as it was used up, or to deliver a fifty-ton batch of hot metal after the charging machine had left—not much talk from them. Chuck and Jerry exchanged labor as usual with Four and Six, and spent their rest periods in solitary confinement.

JERRY tried to fill in those gaps by talking a streak and asking questions, with the result that he crammed his head with more steel-making tricks than he could have learned in years of practice, and the heats they turned out were perfect. If Chuck occasionally grew absent-eyed during quiet moments, Jerry forced his tired tongue to renewed efforts until the eyes focused again. It carried over into their off-duty hours as well, for Jerry insisted upon Chuck's becoming his roommate—and in the darkness of the night heard a dreamer's mutterings that had to do with "whipping it."

"Why don't ya tell 'em the truth?" Jerry demanded hotly of Pat one day. It was not exactly the thing to do, this criticising the morals of one's boss, but Jerry

(Continued on page 23)

The Most Spectacular

How Automobile Racing Makes Cars Faster, Safer and More Comfortable Episodes of Famous Races

By PETER VISCHER

"THEIR engines roaring, their cars never more than a few feet apart, the two lurched around that treacherous dirt track—Barney Oldfield in his famous Bateau Bens and his bitter rival, Ralph De Palma, in a monster Fiat—cars capable of bettering two miles a minute. Suddenly, on a turn, a cloud of dust belched up, as if from an explosion. And from it shot only one car—that of Oldfield.

"It looked like certain death for De Palma, and I ran from the judges' stand with my heart in my throat. He lay crumpled, almost smothered in soft dirt, but alive. A blown tire and not the collision we had feared had thrown him off the course and against the outside fence."

Fred J. Wagner was talking. Fred Wagner, famous starter of automobile races, who has seen more exciting races than any man alive. He's been at the racing game, most spectacular of all sporting events, since the first thrillingly torturous days of the Vanderbilt Cup. You can attribute his slim athletic figure and alert eye, if you will, to his agility in dodging racing cars.

The duel between Oldfield and De Palma, fought in New Orleans one Mardi Gras day, stands out in Wagner's memory as his greatest thrill in sport. To him it rises above spectacular cup races, hard-fought road races, desperate hill-climbs,

Remarkable photo of an accident at the Ascot track, Los Angeles, when Gus Schrader threw a wheel. The wheel can be seen leaving the car

beach tests, and this man ought to know for he has waved the checkerboard flag signifying victory at every one of them.

Oldfield and De Palma that fateful day were contesting on a dirt course of a mile to racing cars far too fast for the track. The excitement was intense, for they were then the country's most famous racers. Each had won one ten-mile heat and they were off to a flying start on the third and deciding race. For seven miles they shook dice with death as they thundered down the stretches and swished around the turns with wheels all but locking. Then—disaster. De Palma's car turning turtle though the driver, hurled into a bank of soft earth, escaped with broken ribs.

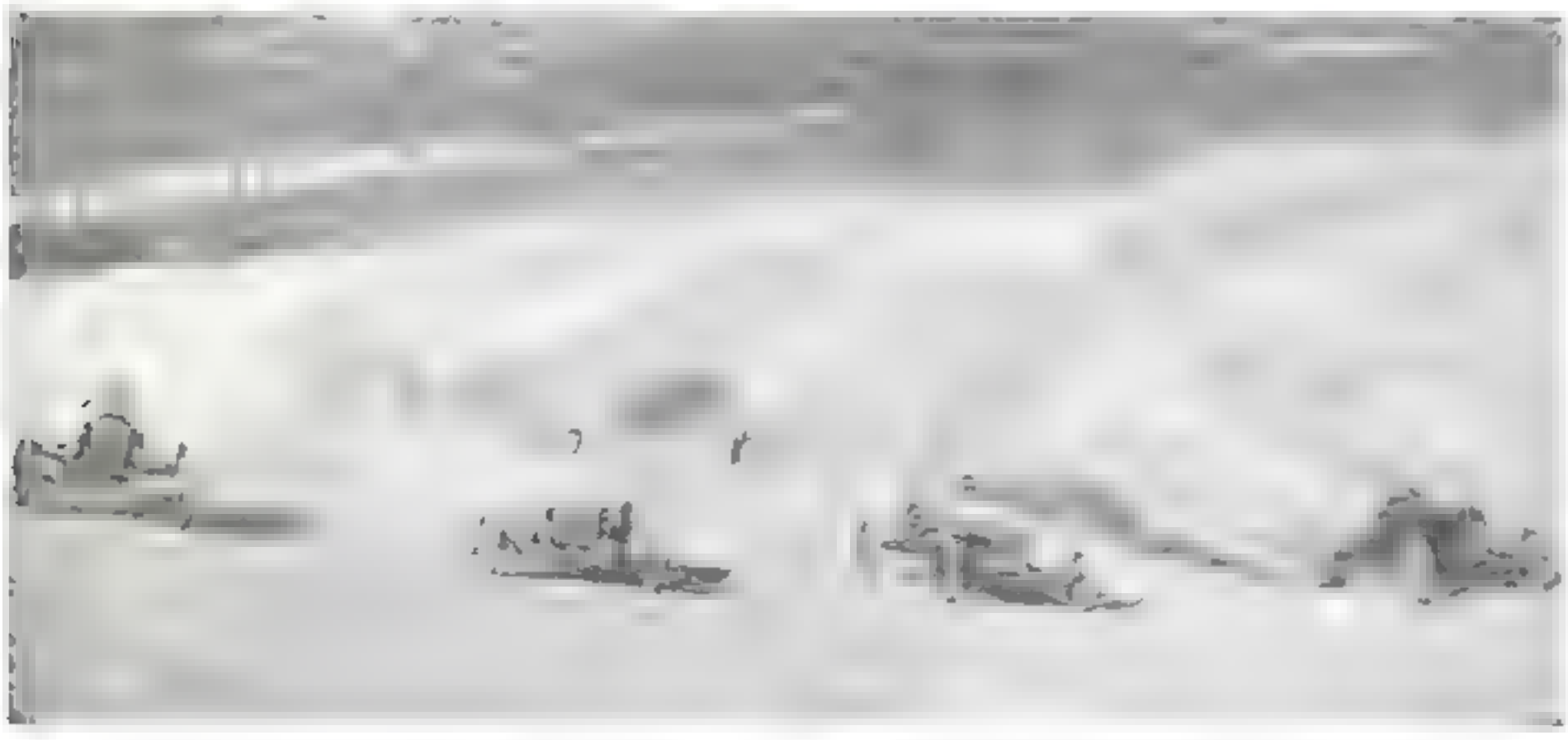
All for sport and its glories?

Well not exactly. While racing is generally looked upon as a sport, there is really much more involved. Racing men will tell you that the automotive science needs racing always has and always will. They say that there is hardly an improvement in modern automobiles that cannot be traced to racing.

As the result of such gruelling outdoor tests have come four-wheel brakes, balloon tires, eight-in-line engines. Constructive racing, with its terrifying speed, has given your automobile a quicker get-away, acceleration, flexibility and a hundred and one other features of which you are proud.

IN A way, it is exhilarating and romantic that something so intensely practical should be considered a sport. Ask the racing man will tell you that the 500-mile international automobile race held every Decoration Day on the Indianapolis Speedway is the greatest sporting event of the year. You can't argue with a followee of automobile racing by citing a heavyweight championship fight, or a gridiron battle between the Army and the Navy, or a World's Series baseball game, or the Kentucky Derby.

Official figures show that last year a crowd of 145,000 paid to watch the Indianapolis race. The rain-soaked mob that saw Gene Tunney batter Jack Dempsey's heavyweight crown from his head numbered 125,505. The melodramatic Army-



Blots of color streaking down the speedway, clouds of dust, roaring engines, man and car strained to breaking point—little wonder they call it "the most thrilling, most reckless, most dangerous, most valuable sport." Photo shows seven speed demons on a turn at Los Angeles

Sport *in the* World

They're off! Typical scene at the start of an automobile race at Brooklands, England. No sport draws larger crowds of frenzied spectators, or carries greater hazards for participants

Navy football game at Chicago drew 100,000. The Derby draws no more. Baseball attracts comparative handfuls.

Literally, they come from the corners of the earth to see the Indianapolis race, for it is the climax of the automobile racing season. It wears the Blue Ribbon of Motordom, and is at once the most thrilling, most reckless, most dangerous and most valuable contest of the sporting year.

Wagner's favorite incident is only one of a great store dealing with racing life. There was the first, for instance, of a Gold Cup race at Savannah, in which David Bruce-Brown, wealthy amateur sportsman later killed, won a 400-mile road race from the famous Frenchman Wilbur D'Hemery by the margin of forty-eight hundredths of a second! Then there was the time something went wrong with Le Patourel's car at Indianapolis at the very moment victory was in sight, and the doughty Italian, heartbroken, jumped out and with perspiration mingling with his tears pushed his heavy car across the line. And there was the heroism of George Robertson, first American to win the Vanderbilt Cup, who virtually cut his car in half on a telegraph pole to save a pedestrian—and lived to tell the tale!

Notice that no story from a racer, or a race official, or a true racing enthusiast, tells of death or disaster—though there is no sport more dangerous, no livelihood more hazardous. Close finishes, great victories, gallant rescues, life—and only life—these interest the racers.

Small wonder, for death has hung a heavy pall over automobile racing, from the early haphazard days, when the first Vanderbilt Cup race on Long Island killed three and maimed more. Take, for instance, the bloody Vanderbilt Cup race of 1910, said to have been watched by half a million people, when five were killed and twenty badly hurt. At a far less important race the next year at the New York State Fair [illegible], nine were killed and [illegible] injured in [illegible]

For one horror-struck moment the crowd gazed speechless, when this car turned turtle; then breathed again as the driver crawled out muttering something about "a narrow escape." Accidents on the speedway are often fatal, although, in the upper picture, taken during a race at Santa Monica, this driver, too, was unhurt

The list of great drivers who have given their lives to the sport is a long one, and runs from those who are safe-and-sane to those who are reckless daredevils.

JIMMY MURPHY, invariably a sensible pilot and considered by many the champion driver of all time, was killed the first time he overreached himself trying to make up impossible ground. Joe Boyer, always rash, was killed at a time when he was taking things easy. Howdy Wilcox, Dario Resta, Bob Burman, Teddy Tetzlaff, Gaston Chevrolet, and many more, all great pilots—all are dead. Killed, you get say, in action.

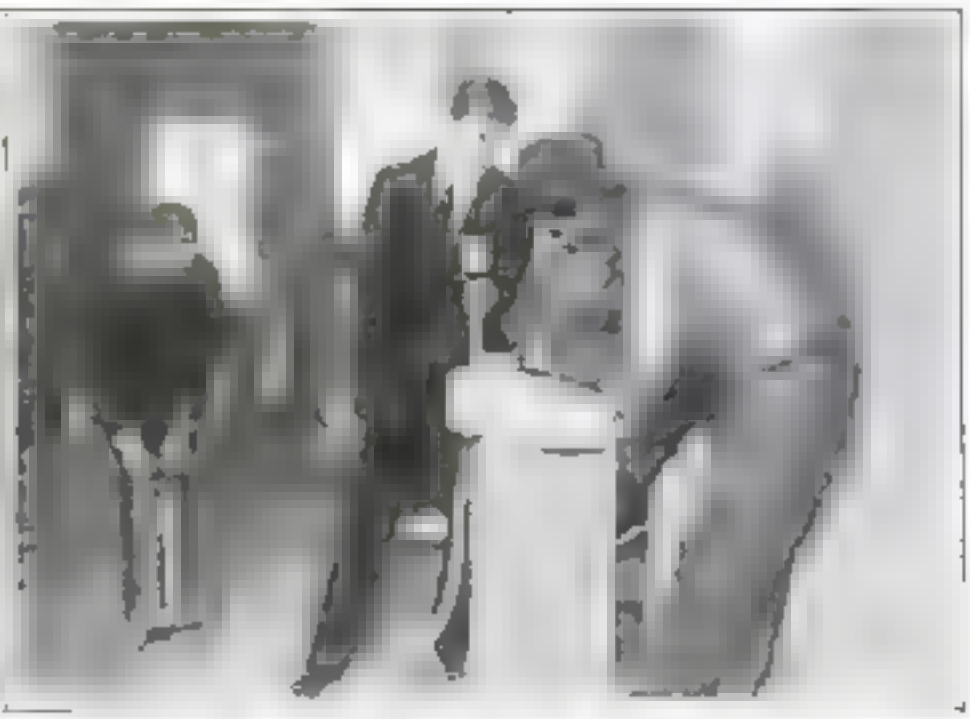
Fortunately, they don't all have to give their lives to the sport.

Tommy Milton, only two-time winner of the Indianapolis event and the man who has traveled faster on four wheels than any other American—156.04 miles per hour by official count on the sands of Daytona Beach, in Florida—retired last year quite intact. After thirteen years of racing, he retired independently wealthy, possessor of more records than any other driver.

Milton, a 200-pound athlete who could have made good at any sport, made more than $100,000 a year during the three big years of his racing career. Possibly half a dozen drivers can make that much a year, for the prize money

(Continued on page 136)

Salt Lake City is fighting soot and dust with scientific instruments. The one shown here measures the pounds in metal smelter fumes



A device to measure particles of dust in industrial plants. The air is drawn through a tube containing sugar, used to collect dust particles

Smoke Costs You $16 *a* Year

How Our Cities Are Seeking to Purify the Air We Breathe by Washing Away Tons of Poisonous Soot

By George Lee Dowd, Jr.

MODERN cities have made enormous progress in cleaning out their dirty corners and purifying their food and drink, yet until very recently they have given hardly a thought to supplying their people with clean air to breathe.

To emphasize this point, a noted specialist attending a luncheon in his honor in a great middle western city recently took samples of the air in the room. These samples, analyzed, showed that in every cubic inch of that air floated thousands of minute particles of dust and soot, so small that 150,000 might be placed side by side in an inch! Moreover, riding astride the particles were countless microscopic bacteria, potential spreaders of disease.

It was an astonishing revelation. From that moment this particular city set about cleaning its atmosphere. It established a smoke inspection department to put an end to the blasts of soot hurled from chimneys and to show manufacturers and householders how to burn furnace fires with the least possible smoke. Its street cleaning department developed improved methods of washing and vacuum cleaning to replace the dust-raising sweepers then in use. And it established a special laboratory in which to analyze samples of air taken from various sections of the city.

Other cities have been aroused to similar action, for chemical analysis has revealed their atmosphere to be charged literally with thousands of tons of dust, stone, coal, cinders, ashes, dusts from industrial and building operations, paving dust from traffic, pollen, decayed organic matter, soil dust—these are only a few of the kinds of foul matter which city dwellers inhale with every breath. Mixed with it too, are injurious gases from manufacturing plants and the extremely poisonous carbon monoxide gas from the exhausts of automobiles.

Belching clouds of smoke from locomotives cost us millions of dollars a year

Of all these substances, probably the most harmful and costly is the soot from coal burned as fuel. When you inhale particles of soot, some of them lodge in your throat and nasal passages. Finer particles reach your lungs. They carry the active germs of colds, influenza, pneumonia and even tuberculosis. Moreover, soot sours and damages clothing, curtains, draperies, woodwork—in fact it injures almost every surface with which it comes in contact, including vegetation.

From tests such as this, at the U. S. Bureau of Mines in Pittsburgh, we may learn much about atmospheric conditions under which we can work

SMOKE costs the people of the United States $1,879,000,000 a year, according to one expert's estimate. This is equivalent to about $16 for every man, woman and child in the country!

In America's smokiest city (which, by the way, is not Pittsburgh) every square mile was covered last year with 775 tons of soot which fell from the air! In the smokiest districts, it has been estimated, the soot particles breathed every hour by city

(Continued on page 158)

If I Fall into the Sea—

The Airman Who Flew to the Pole Tells How He Plans to Hop from New York to Paris

By COMMANDER RICHARD E. BYRD, U.S.N.

THE minute the World War ended I began laying my plans to hop the Atlantic. In May, 1919, Commander Reed, U.S.N., did the trick via the Azores, covering 2,150 miles in 26 hours 45 minutes, not counting his stopover at Ponta Delgada. In June, 1919, Alcock and Brown flew from Newfoundland to Ireland, 1,960 miles, in 16 hours, 12 minutes.

The "Big Hop," from New York to Paris, a traverse of more than 3,600 miles that will take about forty hours, has yet to be made.

I should like to be the first man who flies from New York to Paris by airplane, because that man will be one of the great benefactors both of aviation and of civilization.

For my flight across the Atlantic, and later, perhaps, for a flight to the South Pole, I propose to use a three-engined monoplane. It will be similar to the plane I used over the North Pole, but will have a wing spread of seventy-three feet, ten feet more than the polar plane. I plan to have its center of gravity as far forward as possible to avoid Fonck's trouble in getting his craft's tail off the ground.

Commander Byrd (left) and Pilot Floyd Bennett under the nose of the three-engined monoplane which carried them on their epoch-making flight to the North Pole. Commander Byrd will use a similar plane for his New York to Paris flight in June

ONE especial improvement I propose to make lies in the fuel tank. If we stall over mid-ocean, or find that for any other reason we must alight, the first thing is to dump our fuel. This requires special dump valves in our tanks. We should be able to empty on a little more than a minute. If we are up 1,000 feet or more we can do this easily while gliding down. My plan is to have the tanks water tight. When I close them after dumping gas they will become pontoons to help keep us afloat.

If we are forced to descend into a stormy sea, a lot depends on whether it is daylight or dark. At night, with no light, it would be impossible accurately to gage a descent. A rough sea in any event would be dangerous. I think the best thing would be for us to dive in head foremost and not try to porpoise. This would be a rough jolt, and it might rip off some of our trimmings. But it would save the wrenching blow that would result from hitting a big comber at an angle.

My crew will consist of two men besides myself. One will alternate with me as pilot, so I shall be free to navigate. The other will be busy with the radio and in keeping up minor repairs and adjustments on the engine.

In this connection I propose to have my engines easily accessible. In most multiple-engined planes the outer units are clear of the fuselage and cannot be reached from it. With a good "trouble-shooter" and accessible engines I feel that my chances for success in a long flight are enormously extended.

Naturally I must consider disaster if I make the attempt. It would be foolhardy, and unfair to my companions, if I put all my energy of preparation into academic study of engines, materials and navigation. I have especially scrutinized the records of the late Commander John Rodgers' remarkable experience when he was lost in the Pacific some time ago. He tried to fly from San Francisco to Honolulu, fell into the sea, and finally sailed to one of the islands north of his destination.

THE significant fact of Rodgers' feat was that a multitude of naval vessels failed to find him.

The astonishing thing is that any naval strategist can prove on paper the impossibility of such failure. We have geometrical methods of search by a force of ships that enable a squadron commander to comb literally every inch of any given area. These methods failed in the case of Rodgers. I lay the failure not to any ineptitude on the part of the searchers, but to the fact that theory doesn't always apply out in the middle of the ocean.

Remember that a plane forced down in mid-Atlantic may unwittingly have gone hundreds of miles off her course during the night. She may be far and far to one side of traffic lines. She may be far drift miles farther. It is quite possible for a helpless plane to swing around unseen for months in the great slow whirlpool of the North Atlantic known as the Sargasso Sea.

In such circumstances I would at once cut my wings and engine adrift. I would rig some sort of jury mast and set sail for the nearest land. It is unlikely I would succeed on such a wild voyage. But in emergency no chance is too desperate to try.

NATURALLY I should have fishing tackle aboard. We should doubtless eat our catch raw, as fuel would be either lacking or scarce in our effort to lighten our strange craft. My experience with the Eskimos in 1924 taught me that raw meat is nothing to shy from.

The problem of water would be our greatest one. Experiences of aviators lost in the desert have demonstrated the

value of radiator water as a plane's reserve supply for drinking. But no such reserve is available in an air-cooled motor. Of course, I will take several gallons when I hop off. I dare not take much because every ounce of water at the start reduces by that much our precious fuel. We shall have to depend mostly on water caught from rain. I think thirst would be our greatest suffering if we should crash in mid-ocean.

IN ADDITION to the usual indicators of speed and altitude, fuel and oil, I shall carry a special long distance short wave radio sending set. I hope this will keep me in touch with land at all times during the flight. Remember, a trans-Atlantic air course lies generally over the ship lanes. For this reason I ought to be in continual communication with some vessel or other. Thus, in good weather darkness may not be an appreciable handicap. Hop-off for a New York-Paris flight should be at the first streak of dawn. All that day and night, and all the next day will be spent in the flight, certainly forty hours. Before dark on the second day, I should hope to reach our destination. Here again the "Great Circle Course" would help much because it would take us close to, if not actually over, the southern portions of Ireland and England.

The best month to fly the Atlantic is June. The weather then is generally fair. The prevailing winds are from the west. A ten-knot following wind for forty hours means 400 nautical miles of fuel saved. A storm is possible. But we would not fear it—if it were behind us. Also, since storms come up the coast, we should expect warnings by radio.

I HOLD that the danger of a trans-Atlantic hop is far less even than that of an average cross-country flight. If the ocean plane crashes it will float for days. The ocean is large—one of our pilots

[illegible] I have met a few skeptics about the value of a trans-Atlantic flight to aviation. Take the worst view, that it is just a stunt flight. Stunt flights that are properly organized and equipped, that are not reckless, are almost the only effective means of jolting the public into keeping aviation. When Sir Alan Cobham flew up the Thames river not long ago, after his memorable flight from London to Cape Town, and was welcomed home by a mob of 100,000 Englishmen he had more to promote aviation than all the fiery British eloquence and millions of pounds sunk in research of that whole year.

Bennett and I, in our 1500-mile jaunt to the Pole and back without a hitch, believe our great success lay not in reaching the axis of the earth but in proving such a hop was safe. It took a stunt like that to convince skeptics that aviation is a practical and comparatively safe method of transportation.

These are one or two of the untechnical gains to be had from a stunt flight like that from New York to Paris. There are even more specific and numerous profits in a technical way.

Engine endurance is easily tested in our naval aeronautical laboratory in Washington, D. C., and at the various commercial air plants throughout the United States. The engine is simply mounted on a block and run. It can be run indefinitely, that is, until it breaks down due to the failure of one of its parts, such as a piston or cylinder. Reason for such breakdown can be determined and an improved piston or cylinder installed for the next test. After a while an engine which at first broke down after ten hours may run fifty hours without failing.

This is all very well for the laboratory, but it won't do for the air. That is to say, an engine that will run fifty hours on the block may break down after five hours in the air. The block doesn't yank violently from side to side and up and down the way the plane does. And the barometric pressure in the laboratory remains almost constant, while that aloft may alter abruptly when the plane passes through various strata of the atmosphere. Thus, neither gyroscopic forces nor carburetion can be fully tested except in long endurance flights.

I am especially keen about the navigational problems of a trans-Atlantic flight. The New York-Paris air passenger service of tomorrow must fail almost before it starts if it cannot run on schedule. I do not believe I am exaggerating when I say that we are closer to solution of our engineering problems in such a service than we are to our navigational ones.

WHEN I flew to the Pole last year there was no darkness, very little athwartships wind, a low and constantly visible sun, and an ice pack always underneath us on which we could measure our drift. Flying forty-six hours over the ocean, however, entails at least six hours of darkness. Part of the time the surface of the sea may be invisible in mist or fog. Sun sights at the latitudes traveled must be taken of an orb that rises and sets; not, as in the Arctic, of a bright disk that rolls around a clear horizon.

In a ship or plane the compass needle floats. As the vessel moves around the compass needle stays still, its north end always pointing north. In the compass bowl is a line, called the lubber's point, representing the fore and aft axis of the craft. The line is kept at a certain distance, called the course, away in either direction from the north point. If the course is east the lubber's point is kept ninety degrees away from the north end of the needle.

NATURALLY, in the air, as on the water, the helmsman will make small errors in his steering. Involuntarily, he swings slightly. Sometimes there is an error in the compass itself, owing to the effect of surrounding masses of metal. Such errors are far more serious in a plane than on a ship. On a ship going at twenty knots an error of a degree by her helmsman at night will not put her far off in miles. But in a plane going at 125 miles an hour a slight error will put her hundreds of miles off.

Moreover, the chances of error in steering on an ocean liner are far less than in a plane. A liner's gyro-compasses can be adjusted to a fraction of a degree. She can check with her several magnetic compasses. And she (Continued on page 142)

Commander De Pinedo at the plane in which he recently flew from Italy to Brazil

COMMANDER BYRD'S courageous attempt to fly across the Atlantic is made more thrilling by the fact that other flyers, at home and abroad, also are in the race for long-distance honors. As this is written, at least six other ocean-crossing flights and two Polar expeditions are planned for the coming months. They include:

- A nonstop Paris-to-New York flight planned by Tarascon, French war pilot.
- A New York-to-Paris hop headed by Commander Noel Davis, U. S. N., backed by the American Legion.
- A probable second attempt by Captain Rene Fonck, the French ace who crashed last year, to fly from New York to Paris.
- A "grand circle" flight by way of Paris, Dakar, Buenos Aires, Panama, New York, and back to Paris, to be undertaken by two other French army airmen.
- A flight from Buenos Aires to New York and return by Jorge Carlotti, a Frenchman, and Hector Pedro, of Argentina.
- A "pony-to-moon" hop from San Francisco to Honolulu by C. K. Vance, American air mail pilot.
- A trans-Pacific flight from Vancouver, B. C., to Honolulu, Fanning Island, Fiji Islands and New South Wales by former members of the Royal Air Force from Canada and Australia.
- Aerial explorations over the Polar sea from Alaska by Captain George H. Wilkins, using three planes.
- A flight to the South Pole planned for later in the year by Commander Byrd.

The S-48 safe [illegible] docking again

How Locomotives Pulled Stricken Submarine Ashore

OUT on the water at the Portsmouth, N. H., Navy Yard, floated the submarine *S-48*—wrecked on the rocks of Jeffrey Point in January, 1925. On shore, some 500 yards away, stood three puffing bulldog locomotives, hitched in tandem. Between stretched a mile and a quarter of steel cable.

The job assigned the locomotives was to pull the thousand-ton submarine out of the water and up inclined ways within the famous old Franklin shiphouse. Could they do it?

At a signal, the engineers opened the throttles. Two short tugs—to pull the slack in the cables; then the three bulldogs, roaring and growling, strained at their leashes, combining 85 700 pounds of steam power. They began to move; the cables, taut as rigid bars, slid over their pulleys, and the nose of the submarine cut through the water. In exactly sixteen minutes and five seconds, the boat was dragged on to the ways!

So was completed, a few weeks ago, a feat that amazed naval men and engineers everywhere, under the direction of Lieut. Carleton Shugg. Special drawbars, pulleys, and telephones aided the undertaking. The *S-48* will now be reconditioned.

Glenn Curtiss—Air Pilot No. 1

Glenn Curtiss in the *June Bug*, July 4, 1908—the first pronounced public airplane flight ever made

Experiments and Triumphs of One of America's Pioneers of Speed—Third in a Remarkable Series of Articles

Curtiss' license as an air pilot, the first issued in America

By Frank Parker Stockbridge

GLENN CURTISS was the most excited of all those who watched Tom fly the *White Wing* that day in May, 1908. Jubilant over their first real flight without a stunt, the members of the Aerial Experiment Association gathered in the Canadian "tabernacle" to celebrate now none. A telegram was sent to Selfridge to tell him what success had done. The young lieutenant of artillery had been responsible for the design, but it was a corner of Curtiss' engineering, prowess which had kept the *White Wing* on an even keel. So the others agreed, though the long, lean director of experiments deprecated then as now every attempt to give him credit above the others. Like the famous musketeers, their motto was "all for one and one for all," and Glenn Curtiss had no desire for the outstanding rôle of d'Artagnan.

Four young Americans boiling with ideas and energy, keenly determined to master the mystery of flight sitting nightly at the feet of wisdom with Professor Bell—an unbeatable combination. Something big was bound to come.

Now they had it, the answer to the problem of lateral balance—the aileron.

The aileron, the key to successful flying. Professor Bell's "boys" had hit upon it there at Hammondsport in their second machine! The Wright brothers had a scheme for warping the wings, so that, when the machine tipped, the lower wing offered greater air resistance than the upper one. But that was covered by the Wright patent. Moreover, it involved structural weakness in the wings, and limited their possible size and load. Another way had to be found, and they had found it.

Hence the jubilation in the thinkorium.

"Casey" Baldwin had named it that, or perhaps it was Tom Selfridge. The name fitted the little building on the Curtiss homestead where the A. E. A. gathered Curtiss and McCurdy, Baldwin and Selfridge, and always, when business did not call him away, the beloved Professor Bell.

"He stimulated thought," Glenn Curtiss told me. "Directed it, too, one guesses. They didn't need stimulants, mental or physical, these exuberant young men. Even the thrilling problem of balancing flying machines could not dispel their energy, as witness the day when Casey Baldwin and McCurdy casually commandeered a couple of motorcycles from the Curtiss factory and, coatless and hatless, started off to call on a girl in Hamilton, Ontario, one hundred and fifty miles away!

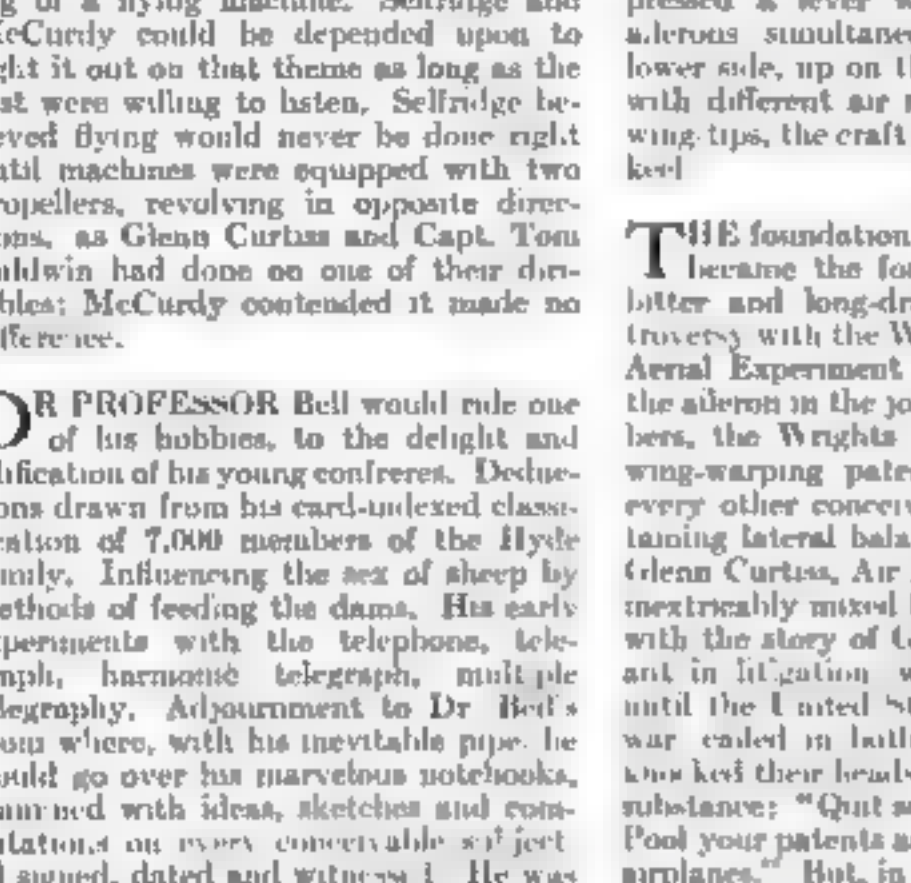
EVERYTHING under the sun they discussed there in the thinkorium. The minutes of the A. E. A. preserved in the archives of the Smithsonian Institution at Washington, are alive with stimulating thought-starters. New ideas, theories, hobbies. Sometimes these debates had to do with flying, as often they related to anything else imaginable.

Atmospheric pressure, tetrahedral con-

struction, the possibility of a vacuum motor; argument piled on argument as to the effect of propeller torque on the steering of a flying machine. Selfridge and McCurdy could be depended upon to fight it out on that theme as long as the rest were willing to listen. Selfridge believed flying would never be done right until machines were equipped with two propellers, revolving in opposite directions, as Glenn Curtiss and Capt. Tom Baldwin had done on one of their dirigibles; McCurdy contended it made no difference.

OR PROFESSOR Bell would ride one of his hobbies, to the delight and edification of his young confreres. Deductions drawn from his card-indexed classification of 7,000 members of the Hyde family. Influencing the sex of sheep by methods of feeding the dams. His early experiments with the telephone, telegraph, harmonic telegraph, multiple telegraphy. Adjournment to Dr Bell's room where, with his inevitable pipe, he would go over his marvelous notebooks, crammed with ideas, sketches and computations on every conceivable subject all signed, dated and witnessed. He was always the last to retire; his habit was to work in the quiet of the night and sleep until noon. Like Frankenstein, his own creation, became a menace, so the telephone bell as he might with towers, it persisted in awakening him. "Little did I think, when I invented this thing, that it would some day rise up to mock me!" he exclaimed, disgustedly, to Glenn Curtiss.

Visitors with hobbies to ride, inventors "nuts" of all kinds flocked to Hammondsport. If they seemed to have anything to contribute they were invited into the Curtiss workroom. Sometimes they had something worth trying. One, Professor W. J. Lyons, had conceived the helicopter, to rise vertically. It was easy enough to try it out, so they built one. Built it, and, to everybody's amazement it did rise almost a foot and a half into the air under its own power.



In the machine Curtiss won the Gordon Bennett prize in France in 1909. Note the aileron between the wings. Left: Prof. W. Lyons is shown with his helicopter, the first to rise under its own power

But always the debates in the workroom came back to the matter in hand and now they had the ailerons. Just a pair of little wings—the word means that—one on each of the big wings or planes. Now the air pilot could turn his machine sideways by turning the steering wheel which controlled the vertical rudder; he could point the nose up or down by pulling the wheel toward him or pushing it away, and, by leaning toward the upper side when the machine began to tip, his body pressed a lever which moved all the ailerons simultaneously—down on the lower side, up on the higher side. Thus, with different air resistance at opposite wing-tips, the craft came back to an even keel.

THE foundation of successful flight, it became the foundation, too, of the bitter and long-drawn-out patent controversy with the Wrights. For when the Aerial Experiment Association patented the aileron in the joint names of its members, the Wrights contended that their wing-warping patent covered this and every other conceivable means of maintaining lateral balance, and the story of Glenn Curtiss, Air Pilot Number One, is inextricably mixed for the next ten years with the story of Glenn Curtiss, defendant in litigation which was not ended until the United States Government, at war ended in both parties, figuratively knocked their heads together and said in substance: "Quit scrapping and be good. Pool your patents and build us a flock of airplanes." But, in the meantime everybody who built a plane that would fly used the Curtiss ailerons to make it fly: even the Wrights.

Now, with the proof in hand that the aileron's the thing, it becomes Glenn Curtiss' turn to supervise the building of a still better and bigger flying machine. No time is lost. The *White Wing's* flight was on May 22nd. On May 23rd he begins work on the *June Bug*.

Inventor, mechanic, business man that he is, he reveals now another side, the showman. His bicycle and motorcycle racing experience has accustomed him to crowds, exhibitions, he has already learned some of the principles of showmanship from Captain Tom Baldwin, the old parachute jumper and his associate in building dirigibles.

"WELL fly the *June Bug* on the Fourth of July," he tells the others. "Advertise it. Invite everybody interested in flight. Draw a crowd to Hammondsport and prove to the world that we can really fly."

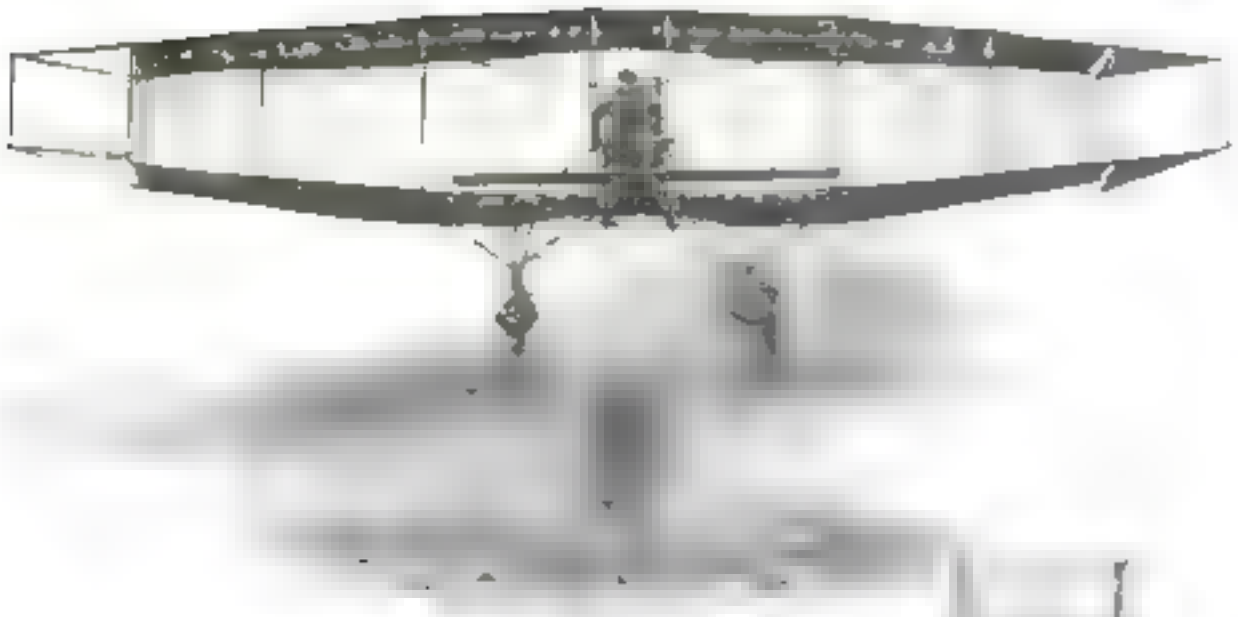
The Scientific American has announced a prize, a trophy to go to the first airman making a public flight of one kilometer, five-eighths of a mile, straightaway. Anybody winning it three years in succession, under different conditions each year, can keep it. There is hardly room on the broad Curtiss mantelpiece for any more trophies, but he decides to go after that one.

Much like the *White Wing* is the *June Bug* when completed. The same eight-cylinder, forty h. p. engine somewhat refined. Larger ailerons. Three landing wheels instead of four. Preliminary tests are satisfactory. The Fourth of July flight is heralded to the world.

Everybody comes to Hammondsport to see a man fly. Newspaper correspondents and photographers, skeptical but curious. A delegation of the Aero Club of America, Allen Hawley Stanley Beach, August Post, great names in aerial circles in 1908. Charles Manly who has built Professor Langley's engine. David Fairchild, Dr Bell's son-in-law. Crestmere lake, George Cary, Wilbur Kimball.

THE Fourth dawns coolly, windily. Already, before five o'clock scores of Hammondsport's citizens, with their picnic baskets, are camped on the heights around Stony Brook Farm. By mid-morning the entire population has turned out. Around noon it begins to rain, but the crowd sticks. Late in the afternoon the sky clears

The *Silver Dart*, fourth plane built by the A. E. A. An innovation was the effort to cool the engine by water—note the radiator made of ordinary piping



In this flying flyer, built by Curtiss, many of our first airmen learned to fly on solid ground, practicing manipulation of the controls until their use became almost instinctive. Upper photo, first year of the flying boat. Curtiss *June Bug* renamed the *Loon* which he attempted to convert into a flying boat by mounting it on pontoons. Note the triangular ailerons, mounted on the wing tips

and the wind dies. The *June Bug* is pulled out of its tent, the course measured, a flag stuck up to mark the kilometer distance. It is seven in the evening before Glenn Curtiss climbs into his seat and the motor starts.

He's in the air! The first exhibition flight in America has started. The first crowd ever assembled in Americ expressly to see a man fly is seeing what it came for. Cheering cries and clicking cameras, but the airman's ears are filled with the roar of his exhaust, his eyes with the red flag that marks the kilometer. He reaches it, passes it, two hundred feet in the air and climbing strong. He lies on and on. Trees ahead! As yet we have not learned how to turn in the air. Here's a level patch of ground. Down for a perfect three-point landing, with the engine at full running like a watch and the tank still full!

AGAIN Glenn Curtiss is the calmest, least excited, of all the clamorous crowd that pours over the hillside to acclaim him. Thirty-one miles an hour the observers announced, after measuring the flight and comparing stop watches. The trophy has been won by a big margin. The newspaper correspondents rush to the telegraph office. Another day has almost dawned before they have finished telling the world what they have seen on this Fourth of July, 1908.

That was what convinced the world that man had actually realized his immemorial dream of flight. The world at large at last believed.

It was McCurdy's turn next to design a plane. He went to work on the fourth of the Association's machines, all the rest cooperating as usual, while Glenn Curtiss began to experiment with the precursor of the hydroaeroplane and flying boat. While McCurdy was supervising the building of the *Silver Dart*, Curtiss was building light pontoons on which the *June Bug*, renamed the *Loon*, was mounted. Safety was one of the things he was seeking; landing on water seemed safer than landing on the ground. If flying were to develop into a world-wide means of transportation, then there must be found some way to alight on water instead of on the few cleared and leveled spots of ground available. Glenn Curtiss was looking far ahead.

"Another thought that influenced my desire to build a water plane," he told me, "was that the need of speedy transportation over water routes was greater than over land routes. Railroads made fast time on land, steamships were slow in comparison.

But the *Loon* did not rise from the water. It weighed, with its pontoons, nearly a thousand pounds. The combination of weight and skin friction was too much for its forty-h. p. engine. It made twenty-five miles an hour on the water and observers thought at times it was actually clear. Only against a strong head wind, however, was there a chance of really getting it into the air, and Glenn Curtiss was not yet ready to attempt to fly in a wind. Nor was anybody else.

HAMMONDSPORT was now the great rendezvous for all who felt an interest in flight. The summer days and nights were crowded with visitors. "Be careful," said a life insurance agent, talking one day with young Selfridge, "or we will be paying money to your heirs." Selfridge joked about it that night in the thinkorium. A few days later he was killed at Fort Myer, Va., the victim of the first fatality in the history of modern flight. With his death the exuberant, boyish spirit of adventure which had pervaded the A. E. A. passed forever. The enthusiasm for flying was still there, but now it was a serious business.

McCurdy flew the *Silver Dart* on December 12, 1908. His previous demonstrations of novel methods of falling off a motorcycle had led his associates to fear he would never make an airman. He became, however, one of the most expert pilots. In the *Silver Dart* at Baddeck, later, he made more than two hundred flights, covering a thousand miles or more, without accident. That was the fourth and last plane built by the A. E. A.

The Aeronautical Society of New York decided to introduce flying to the metropolis. They ordered a plane from Curtiss, to be demonstrated at the old Morris Park race track. It was an improvement on the *June Bug* and the *Silver Dart* only in detail, but had a four-cylinder engine. Glenn Curtiss took it to New York in June, 1909, and on the twenty-second of that month gave New Yorkers their first sight of a man in the air in a heavier-than-air machine. This was the world's first winged aviation meet with mile-a-minute fliers. But the race track was too small and Curtiss, with the officials of the Aeronautical Society, hunted for a better field near New York. They found it on the Hempstead Plains near Mineola which has been the flying headquarters of America ever since.

Here Glenn Curtiss won the Scientific American trophy for the second time.

This year the conditions called for the longest flight made during the year, not less than twenty-five kilometers, about sixteen miles.

CURTISS got off the ground at 5.15 on the morning of July 17, 1909, watched by a little crowd of newspaper men and near-by residents. The course was a triangular one, a mile and a third around. He had learned by now how to bank his machine and turn in the air. Twelve circuits of the course made twenty-five kilometers. He did it in thirty-two minutes. His engine was running smoothly and he kept on until he had made nineteen circuits, covering 24.7 miles.

That was the longest flight anybody had ever made. Only eighteen years ago—and twenty-five miles in the air was a world's record!

The Aerial Experiment Association had been dissolved on March 31, 1909, after deciding that it had an invention in the aileron, the patent application for which was filed on April 8th, with Charles J. Bell named as trustee of the invention and of all other property of the Association, for the benefit of all. Thirty-five thousand dollars.

(Continued on page 138)

Rats That Go to College

French scientists go to Abbé F. Pierlot for white mice, which he raises by the thousand

Petted rodents that live thirty times as fast as men give us new knowledge about our minds and bodies

By H. C. Davis

The white rat is favored of science because it breeds rapidly, is docile and easily housed

THE rat, ancient enemy of mankind, now has been sent to college as the friend of mankind. While the vicious alley rat is hunted and destroyed as a carrier of disease, his favored cousin, the white rat is being pampered and educated by science in remarkable experiments calculated to make the human race healthier, happier and wiser.

At Stanford University in California, 500 white rats, carefully bred, fed and housed, recently have undergone intelligence tests which may lead to valuable discoveries about our mental processes. And in the Crocker Laboratory of Columbia University, some 9,000 pedigreed members of the same rodent family are being studied to learn new secrets of heredity and to gain useful knowledge in combating disease. Indeed, scientific institutions throughout the world today are calling for these long-tailed creatures in such quantities that the raising of well-bred rats on a large scale has established as an unusual American [illegible]

In Philadelphia, the Wistar Institute of Anatomy and Biochemistry has $60,000 worth of special equipment for rearing thousands of the rodents for mankind. From there they are shipped to laboratories in many parts of the world.

THE chief reason the white rat has become the chosen friend of man is that in structure, growth and bodily processes he resembles human beings. Therefore his reactions to physical and intelligence tests can be counted on, relatively, to throw light on our mental and physical machinery.

In the study of habit, for example, the Stanford experimenters, under the direction of Prof. Calvin P. Stone, have tested the ability of rats to acquire new habits and to break old ones. For this purpose ingenious devices are employed. One, called the "problem box," is a screened enclosure from which a door leads to another box containing food. The only way the rat, imprisoned in the problem box, can reach the food is to step on a small platform at the side of the box. An electric current releases the door. Each rat under examination is put through this test once daily for twenty days, and a record is made of the time required to open the door. The records show the rate at which habit is formed. In addition, the test is repeated after a lapse of fifty days to determine ability to retain the habit.

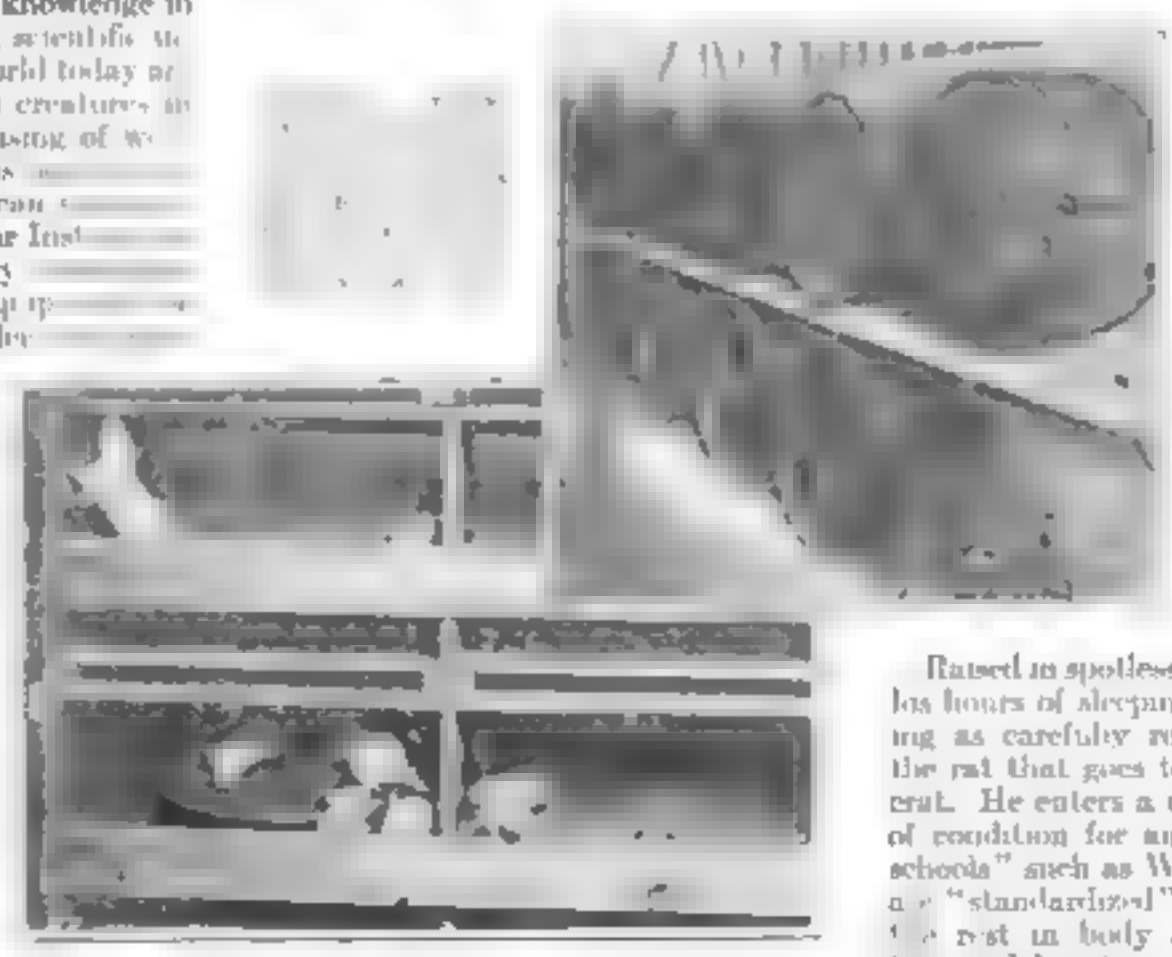
ANOTHER apparatus, "the maze," consists of a labyrinth containing many blind alleys, but only one direct path to the end, where food is placed. In repeated tests, the number of false moves, and the time required to thread the maze, measure ability to learn.

It has been found that the rat develops physically about thirty times as rapidly as a human being. A rat one month old is equal in development to a child two and one-half years old. The tests further indicate, according to Professor Stone, that the rat's mental development will prove to be fifty times as rapid as man's.

IN THE study of heredity rats have proved most valuable. To observe four human generations would require the better part of a century. In two years, rats have told the same story, for the laws of heredity governing the rat family are fundamentally the same as those governing human life.

Recently laboratory rats have helped show how science can exterminate the [illegible] plague-carrying dock and sewer rat. A bacterial culture known as "ratin," has been discovered that kills rats, but does not harm humans or domestic animals. Placed on bait, it spreads an epidemic among the rodents.

Raised in spotlessly clean surroundings, his hours of sleeping, eating and exercising as carefully regulated as a baby's, the rat that goes to college is an aristocrat. He enters a university in the pink of condition for any test. "Preparatory schools" such as Wistar Institute graduate "standardized" rats each one so like the rest in body and health that one testing laboratory can compare its results directly with another's.



Mr. and Mrs. White Rat at home. They sleep, eat and exercise by time clock until ready for their mental or physical tests

A Race *of* Man-Eating Lions!

How strange African breed transmits lust for human blood from generation to generation, and causes terror in native villages

Reported by CAPT. C. R. S. PITMAN

Chief Game Warden of Uganda, British East Africa

"THE man-killers!"

A cry of warning spreads terror through the African village. Women and children scurry to safety. Black-skinned warriors hurriedly gather, armed with nets and spears. Quick death, in the form of a band of fierce man-eating lions, has stalked once more upon the community, slaying and devouring two of the inhabitants.

Now the hunt is on. The warriors beating the bush beyond the town, track the marauders to a rocky hill. There, forming a wide-flung circle, they close in, and at last one of the beasts is bolged within a living fence of fearless spearmen. Overmastered, he cowers, and the spears are driven home. One "ruler of the jungle" pays the price of his lust for human blood.

Mourning its dead, the village lives on in dread. Who will be the next victim? Always its people are asking and wondering. For the maiming man-eaters are abroad, and their numbers are increasing.

Indeed, such a reign of terror have these man-killers caused in certain districts of East Africa—especially in regions of Uganda near Lake Victoria—that today desperate defense measures are being adopted. Every conceivable weapon—gun, spear, trap and poison—is being employed.

Natives live in such fear that they dare not venture abroad in the dark. In one remote district a tribe of man-eaters not long ago completely conquered the inhabitants, putting to flight those whom they did not kill. Near Sanga, a single lion devoured eighty-four human victims, while another took forty lives before it was brought to bay!

The astonishing thing about this new scourge is that the beasts responsible for the depredations are like no other lions in the world. Occasionally man-eaters have been encountered before. But now an entire race of lions apparently has been tainted with a desire for human flesh in preference to their customary prey.

THAT the man-killers have increased in numbers, despite the fact that many have been destroyed, is due to the fact that the lust for human blood is passed on from one generation to the next. The young, inheriting the taint, transfer it to their offspring.

By nature the lion is not man-hungry. On the contrary, the fabled "king of beasts" actually lives in fear of humankind, and when it comes to meeting man face to face is a cringing coward. So, from primitive times, lions generally have confined their killings to easier prey.

The over-zealous man-eaters usually have been aged beasts with bad teeth, or deformed or disabled so that they have found it impossible to hunt their natural prey. Hunger has driven them to human habitations to forage for cattle and fowls. There, for the first time, they may taste human blood, and one taste creates an insatiable desire for more. Lonely, hungry, and infirm, man-killers of this type ordinarily leave no offspring.

THE terrible Sanga lions, on the other hand, are fierce, virile, and strong breeders. When they go man-hunting, they do not go alone, but attack in bands, and their young follow in their footsteps. As in the case of the usual type of man-eaters, however, their inherited desire for human beings had its beginnings more or less by accident.

Some years ago the cattle plague known as rinderpest spread through the district, destroying immense numbers of antelopes, wart hogs and other game animals. Bands of lions, facing starvation, were driven to raid the flocks and herds of the settlements. Soon they came into conflict with men. Quite probably they shared the first few victims.

So the damage was done. Other killings followed, the beasts bred true to type, and the menace grew. Today virtually all lions in the Sanga area are man-eaters, although game now is plentiful. And the scourge is spreading to other districts, some of them as far distant as a hundred miles from Sanga.

One of the most tragic spots in the world today is a bleak African table-land called the Marunga Plateau—a wind-swept grassy steppe interspersed with marshes, valleys, and patches of black, sinister forests. There, among straggling villages, the lions reign supreme. Death, in terrible form, is ever present. As the cringing natives retreat, moving farther and farther afield, the lions follow relentlessly, always ready for the opportunity to attack. The populace, virtually defenseless and dwindling in numbers, has been reduced to a pitiable state of terror.

A characteristic of the man-eating lions which distinguishes them from others is that they are strangely silent. They never roar. Contact with human prey has taught them to rely on cringing to betray their presence by the sound of their voices.

THE man-eaters are so cunning, in fact, that it is extremely difficult to capture or kill them, or to guard against their attacks. They hide in places that are almost inaccessible, and accost unconscious prey. One especially dangerous lion, for example, near Bombo, always accompanied a herd of elephants. When it came to raid the killer ended its forays for the reason that its tracks invariably were obliterated by the great footprints of the elephants. A game ranger who went to investigate was amazed to discover why the lion kept such strange company. It was because, whenever the elephants raided the banana plantations, individual men went out to beat drums to frighten them away. Thus was man-killing made easy for the lion!

Against ordinary lions, poison has proved the most effective weapon. Because of their fondness for carrion, they frequently return to a kill after being driven away—and in the meantime the carcass has been poisoned. Man-eaters, however, are not to be destroyed so readily. They are wise enough never to return to a kill once they have left it. In fact, they seem to have enough of a human kill to make a return worth while. Moreover, they cleverly and consistently avoid poisoned baits.

SPRING traps have proved more effective, though at first the natives, in their ignorance, frequently are averse to using them. Not long ago a terrorized chieftain in a lion-infested area was given a trap to aid in protecting his people. For months he disdained to use it. Then it was borrowed and tried elsewhere. The first time it was set, a man-killing lioness was caught. That converted the chief, who since then has employed it to rid his district of the beasts.

Throughout the man-killing districts game rangers are arousing the natives to concerted action in driving back the ruthless invaders. Once again, in the heart of Africa, there is in progress a bitter struggle to decide the ancient issue:

Which shall be master—man or beast?

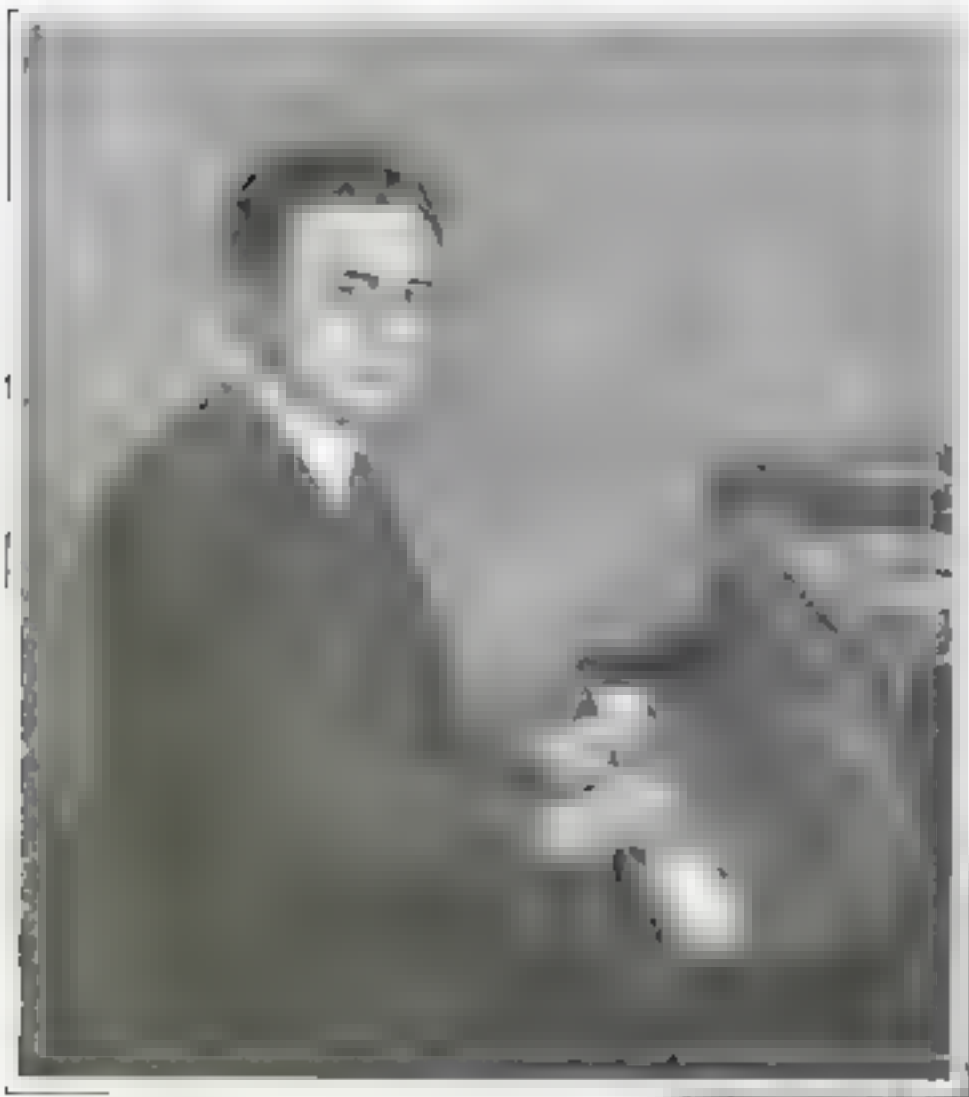
THE man-eating lions of Uganda, Africa, are a new scourge dating from only a few years ago when they had their first taste of human flesh. The taint has proved hereditary. Today bands of them are terrorizing whole districts. They skulk near settlements awaiting their chance to pounce upon the unwary, near Sanga a single lion recently killed four humans. They have developed savage cunning in their depredations, avoiding poisoned bait, refusing to go back to a kill, even hushing their roars lest their presence be betrayed

Magic *Fingers* Win *Double* Fame

Josef Hofmann, World-Famous Pianist, Has Given Us Auto Springs and Other Inventions

By

JACK O'DONNELL



Josef Hofmann, as many of us know him. He is also an inventor of many remarkable devices

Below with his latest invention a device to record differences in pianistic touch on a player piano roll

IT WAS a cold, clear day. Every boy in Berlin whose blood was thicker than water tingled with the call of the ice ponds. Skates dangled and glittered in the sunlight as girls and boys, skating gayly, hurried toward the Spree river or the other ponds and waterways of the German capital.

In a fine mansion home in one of the dignified residential parts of the city, an undersized boy of twelve, who had come to Berlin from his native Poland to study the piano, edged toward the door with a bundle under his arm.

"Where to, son?" asked his mother.

"To see Alfred Joel" answered the lad in an evasion of the exact truth that probably was pardonable under the circumstances.

"What's in that package?" queried the mother, although I imagine she knew.

"Oh, just something that I want Alfred to see."

"Tell me the truth—they are skates, aren't they?"

When the eager-faced boy admitted the accuracy of his mother's guess, she gently but firmly demanded that he give them to her. Bitterly, he had expected this.

"I KNOW it seems unfair to you, Josef," she said, "but I can't permit you to risk an injury to your hands or fingers on the ice. Suppose you should fall and an other boy crushed your fingers under the runner of his skate! You could never play the piano again. No, son, you cannot go skating."

Reluctantly the lad surrendered the skates. Hot tears of disappointment welled into his eyes as he looked out of the window and saw scores of playmates hurrying to the exhilarating winter sport. He resented this curtailment of his pleasure. Why should he, of all the boys in the city, be forbidden to go skating? All would have been well if his mother hadn't seen that package. Next time he would be more careful. He would conceal the skates more cleverly. But how? Skates were skates and they'd make a bulge if he attempted to hide them under his coat. But there must be a way.

ALL that afternoon he pondered the question. Then, about bedtime, a plan took form. The next day and for many days thereafter, the lad sweated and toiled in his tiny workshop, using the tools with which his grandfather, an eminent surgeon, had devised many mechanical appliances.

Came another day when the girls and boys of the city were hurrying in the direction of the river and the skating ponds. It was a perfect day for outdoor sports. The twelve-year-old lad in the musician's home heard the call of the ice, saw the glistening skates of his friends and decided to join them.

"I think I'll go down to the Spree and watch the skaters," he announced casually to his mother, donning his great coat and fur cap.

"Go ahead," the mother said, failing to note the slightest suspicion of a bulge in the lad's pockets.

When the boy reached the river and drew from an inside pocket of his coat a flat case about eight inches long, three wide and one thick, his playmates watched him curiously. He bent over, removed two false leather heels from his shoes, gave a couple of twists to the device he had taken from the box, and to the amaze[illegible] of the others proceeded to adjust a perfectly good pair of skates on his feet! Examination of the odd, folding skates revealed that the clamps that held them to the shoes worked on a pivot so that they could be folded flat against the runner, thus making the skate less than an inch in thickness. The young inventor had dispensed with the heel clamp entirely, solving the problem of a rear fastening by providing a metal plate on the heel of his shoe into which a bulbous piece of metal, attached to the runner of the skate, fitted snugly.

Never again was the boy halted by his mother on his way to the skating pond because of a suspicious bulge in his pocket. For four years he got away with all the skating he cared for by using the collapsible skates he invented under the urge of Mother Necessity.

That his mother's fear for the safety of his fingers was unwarranted is evidenced by the fact that the twelve-year-old inventor grew up and today is one of the foremost pianists in the whole world—Josef Hofmann.

ALTHOUGH Josef Hofmann is known the world over as an artist, few probably are aware that he may justly claim fame as an inventor. For in the fifty-one years that have elapsed since his birth in Cracow, Poland, he has invented more than sixty useful mechanical and electrical devices. These range all the way from extension pedals for pianos to mechanical toys for his numerous children friends, and from a frictionless air spring shock absorber for automobiles to a device to record automatically all the refinements of a master pianist's touch on a paper roll for a player piano.

"Next to my music," he told me recently at the home of Edward W. Bok, at

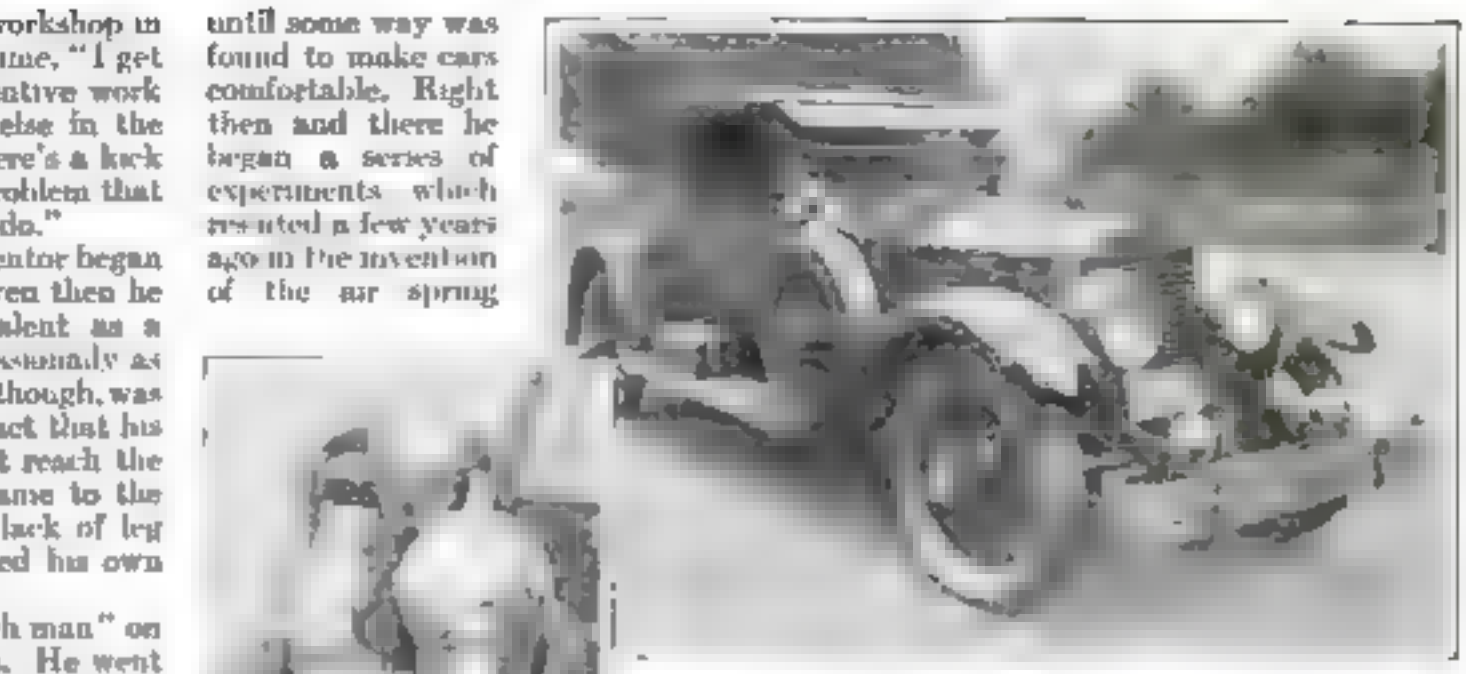
Merion, Pa., where he has a workshop in which he spends much of his time, "I get more pleasure out of my inventive work than I get out of anything else in the world except my friends. There's a kick in overcoming a mechanical problem that thrills me as few other things do."

Hofmann's career as an inventor began at the tender age of nine. Even then he had displayed remarkable talent as a pianist and was playing professionally as a "boy prodigy." His playing, though, was somewhat hampered by the fact that his legs were so short he couldn't reach the pedals. When nobody else came to the front with a remedy for his lack of leg length, young Hofmann turned his own attention to it.

One day he saw a "sandwich man" on stilts. This gave him an idea. He went home and promptly got busy in his grandfather's workshop. A few days later he had the plans of a set of extension pedals—an attachment that fastened to the pedals and extended upward high enough so that his feet made natural contact with it. He then designed a bench on which to rest his heels, using this as a full-grown pianist uses the floor. These extension pedals were used in all the boy's public recitals thenceforth until he "grew up." Even today he has to extend himself to reach the pedals when playing, as he stands only five feet four inches.

HOFMANN, like many artists, is very sensitive to jolts, bumps and jars. He will always take the longest way 'round if it is the smoothest way home. Jolting Pullmans hard riding automobiles and ruble cars shock his nervous system severely.

Thirty-three years ago, when he built one of the first steam-driven automobiles seen in Germany, he began experiments that resulted in the invention of the air spring until some way was found to make cars comfortable. Right then and there he began a series of experiments which resulted a few years ago in the invention of the air spring



Thousands of motorists enjoy better riding today because of the Hofmann air spring shock absorbers installed on the front of the car as shown

shock absorbers which bear his name and are used on thousands upon thousands of automobiles, trucks, motorcycles, airplanes and buses in all parts of the world.

"This air spring is the most practical thing I ever invented," said Hofmann. "I went to work on it in the first place more or less for my own comfort. I enjoy motoring more than any other form of diversion, so I worked pretty hard to perfect something that would make motoring a joy instead of an ordeal. The air spring invention is the result."

The pianist-inventor at play in his garage shop at Merion

IT ISN'T at all difficult to believe Hofmann implicitly when he says he is "not an inventor for profit."

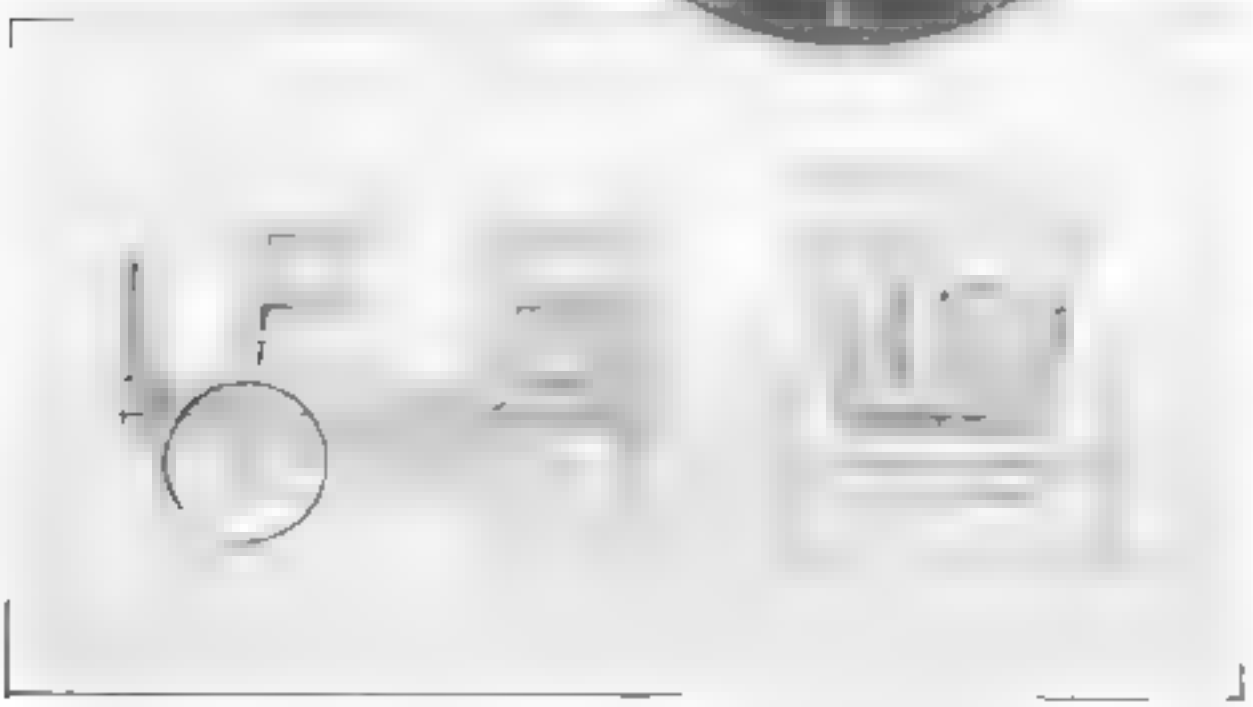
"I invent things purely for my own pleasure. I like to investigate mechanical things to find out what makes them go. There is romance, surprise and a million delights in the game of inventing. And I hold that an artist can become interested in mechanical things without detriment to his art—on the contrary, his art may benefit by it.

"An invention has many points of similarity with a musical composition. From the purely psychological point of view, inventors and composers are not far apart. Both require imagination. Everything that moves or has life in it requires imagination. I should say that in mechanics what interests me is motion, in music it is emotion.

"Many of my best friends cannot understand how or why an artist can be interested in mechanics. But a knowledge of mechanics is actually valuable to a pianist, as an assistance to him in execution—that is, it helps him in the physical side of expression, and in the solution of problems in technique.

"TO ILLUSTRATE: I have often noticed that when children try to play the piano rapidly they lift their fingers very high. They don't get speed for the same reason that a long pistoned engine doesn't develop the speed that a short pistoned motor develops. When one wants to play fast, one must keep one's fingers close to the keys. The music teacher who knows the difference between the action of a long and a short piston will know that the same principle applies to the action of a child's hands on the keyboard."

How does an artist as much in demand as Josef Hofmann find time to do inventive work? (Continued on page 148)

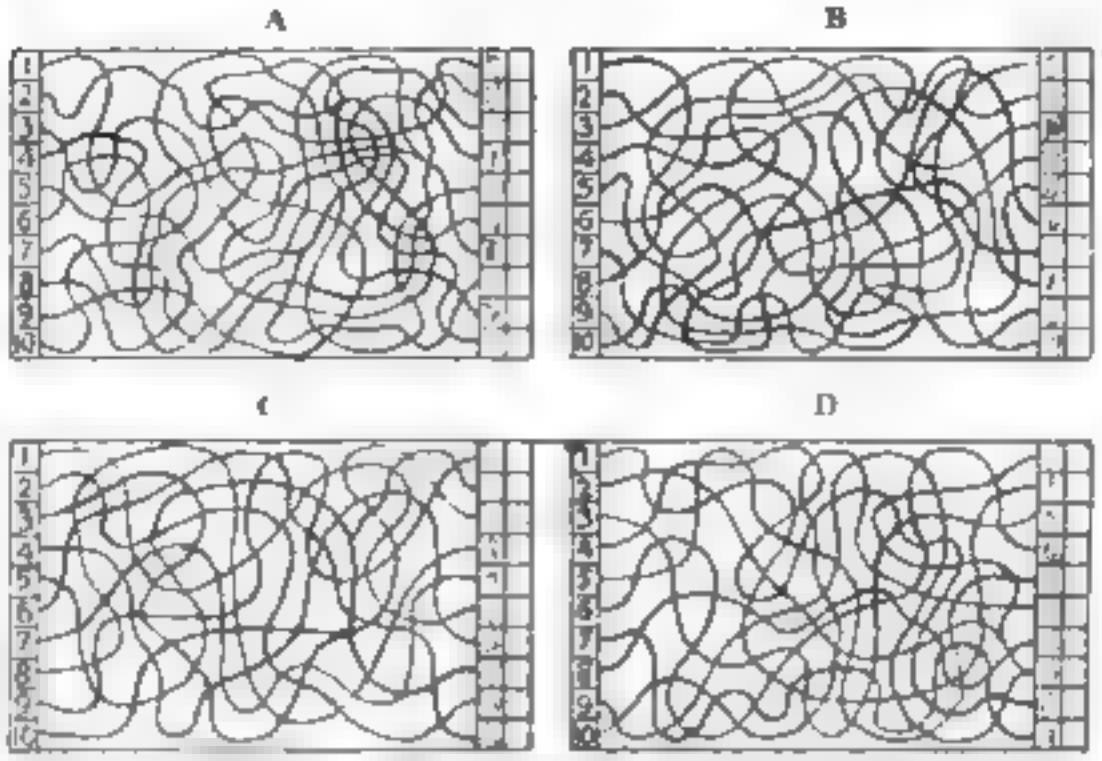


One of the first steam-driven automobiles seen in Germany, built by Hofmann thirty-three years ago. Like virtually all early cars, it followed conventional carriage lines. The boiler was under the rear seat, cylinders were under the front seat. The drawing at right is a combination rear and front view

Test *Your* Mechanical Ability

THE remarkable new tests on this page afford an entertaining and reliable way of measuring your present mechanical ability without the use of workshop equipment. The only tool required is a sharp-pointed pencil. They are so simple that anyone can enjoy them, yet actual practice has proved them to be accurate yardsticks in determining your skill and speed in working with your hands.

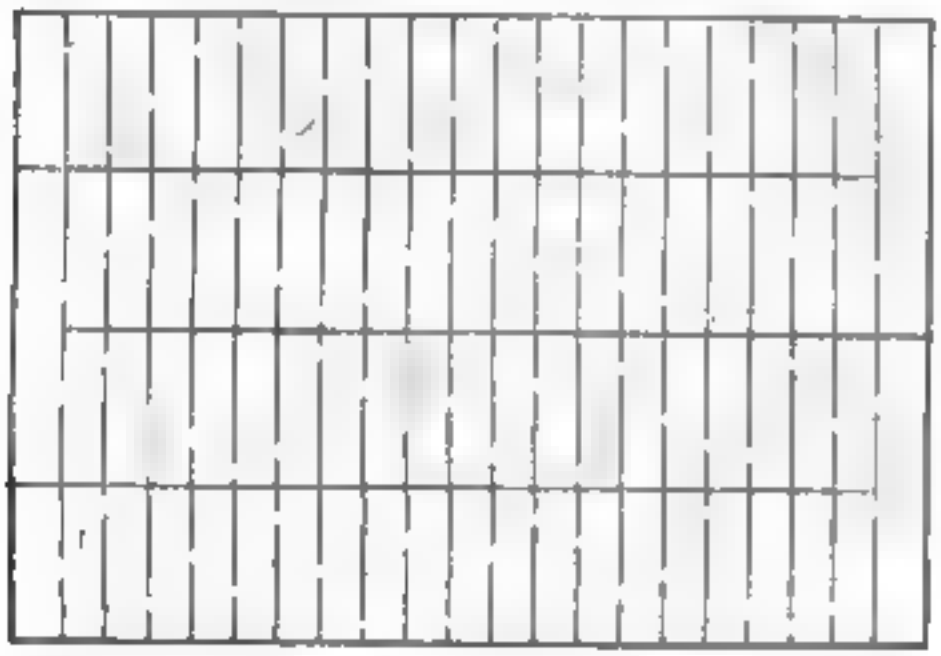
The tests were devised recently by Dr. F. W. MacQuarrie of the University of Southern California and published in the Journal of Personnel Research. They were intended for use in selecting youth



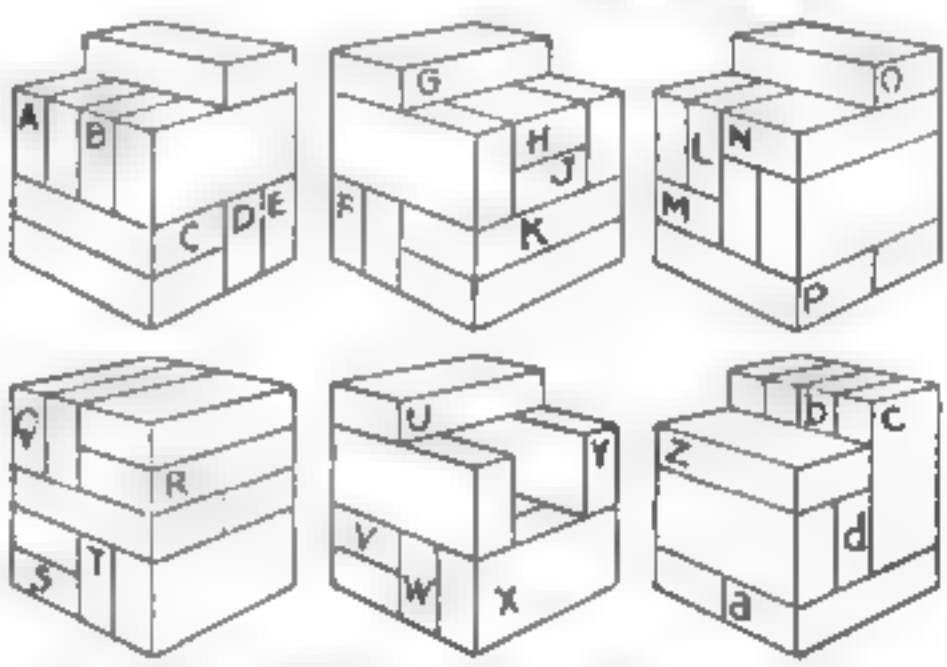
Can your eyes follow a tangled mechanical problem without becoming confused? Starting at the numbers on the left of each figure above, follow each line by eye, and in the blank square where it ends mark the number it had at the beginning. Allow yourself three minutes, then score the number of lines you followed correctly, referring to the answers on page 147. An excellent score is twenty-five, twenty-eight

dates for training as mechanics, and to aid young people to choose the right callings. They measure ability in actual hand-and-mind performance—that is, skill in workmanship and speed in getting the work done.

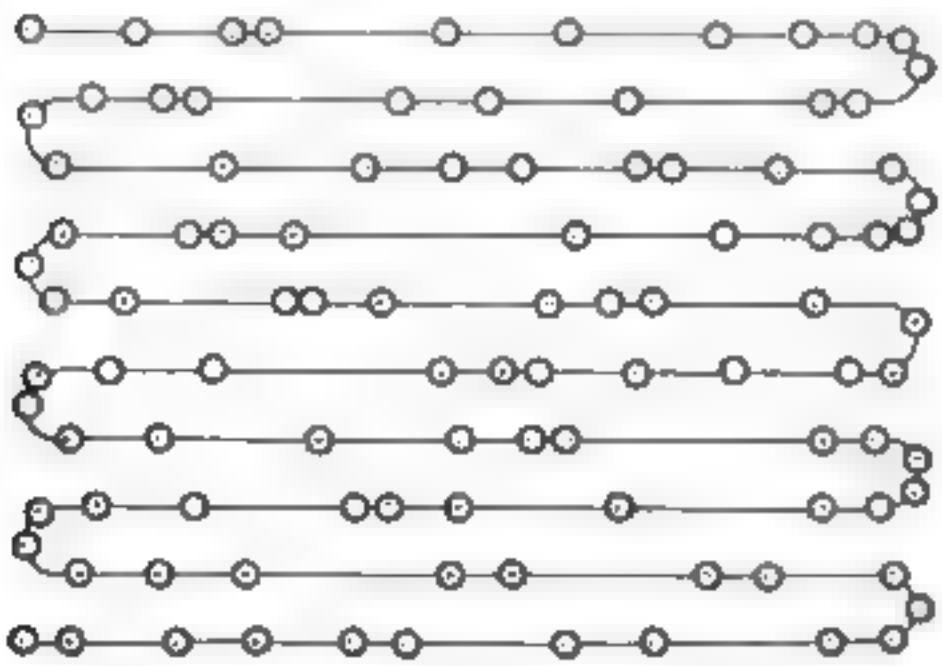
With each test is an explanation of what to do and how to score yourself. Ask a friend or relative to act as judge. When you have completed all five tests, add your separate scores together and divide the total by three. That will give you the score for all-around mechanical ability. If you score seventy-eight or more, you are exceptional; if your score is sixty-five or more, you are well up to the average.



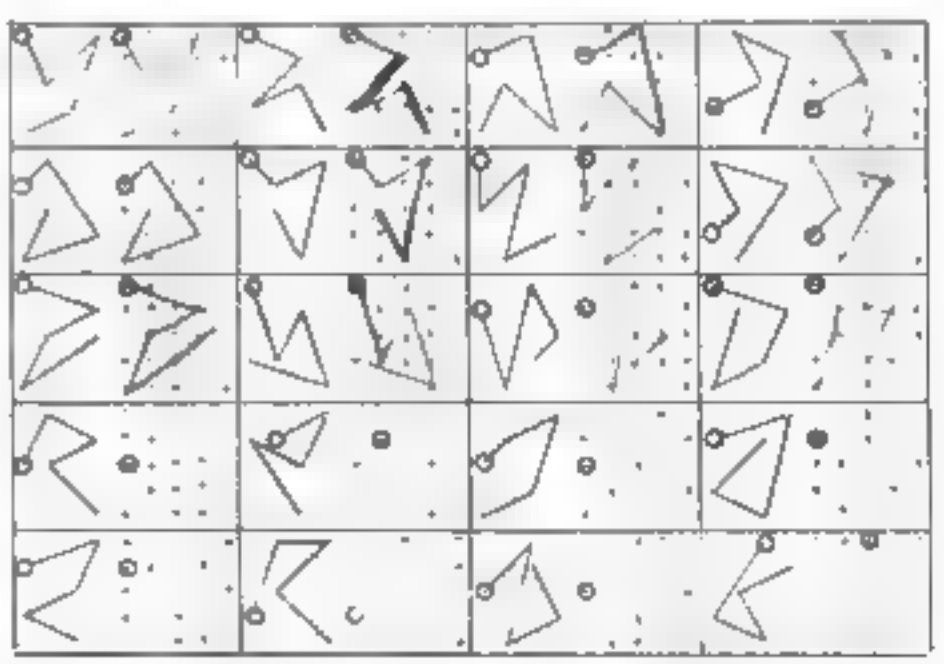
This test tells how precisely you can coördinate mind and muscle in following a definite course. Starting at the dot in the upper left-hand corner, draw a pencil line through the openings in the vertical lines. Allow yourself one minute. Then count the openings your line passes through without touching. Sixty is excellent; fifty is good



These are combinations of blocks measure the accuracy of your perception of space and construction. In each figure five blocks are marked with letters. You are to determine the number of blocks that touch each lettered block. See how many you can do correctly in three minutes. Answers are on page 147. A score of fourteen is exceptional; ten is good



How accurately can you aim, and how steady is your hand? Begin at the upper left of this string of 100 "bull's-eyes," mark one dot in each circle as rapidly as you can. Each dot must be clearly within the circle without touching the rim. Allow forty seconds, then have someone score the bull's-eyes you have made. Seventy is above the average; sixty is good



Here's a fascinating test of your judgment of length and direction. At the left of each rectangular division is a simple figure of four straight lines. Copy the lines as exactly as possible in the dots at the right, as indicated. Allow three minutes, then have someone count the lines drawn correctly. A good score is sixty-five; fifty-five is average

You Have Asked Me—

Questions about Cellars, Floors, Roofs, Masonry, Lumber, Heating, Construction, and Here Are Some of My Answers

Says JOHN R. McMAHON

FASCINATING letters from all parts of the United States and Canada, not to mention Japan and points yet more remote, flock into the home building department of this magazine. They commend, criticize, debate, and mostly ask for specific information in regard to the writer's particular problem.

"How can I build a log house?" asks a reader in British Columbia and ditto for a resident of California. They ought to know how to do the job, perhaps, but we tell them.

"Is a house of rammed earth any good?" asks Montana. Then Virginia comes to bat with a problem of wiring the home—submitted by a civil engineer.

"There is a ticking sound in the rafters of my roof," complains New York, and at first we think of referring the matter to the spiritualist society, but decide that the cause may be a material one. We ascertain from Government scientists what kind of bug plays spooks in rafters and how to wrestle with it. There are questions about insulating material, wallboard, heating, roof covering, lumber, cement, tile, brick and in fact every item pertaining to a house. Plans are widely called for and these requests have to be referred to planmakers or local dealers in building supplies.

A kind of letter especially appreciated comes from a craftsman in the building industry—a Chicago plasterer who says that our articles are all right, but he wants to cite his personal experience with gypsum versus lime. These workers on the job know what they are talking about, sometimes a good deal beyond the limits of their trade. I know a working bricklayer who has traveled around the world and could instruct a college professor in history, English and the game of golf.

Let us consider some of those questions which are most often asked or have some peculiar interest. Take first the query on the rammed earth dwelling. Roughly, the method is to make a plank form for walls and to tamp within the form a mixture of slightly moistened subsoil or clay. Earth costs not a cent, you seem to get a house practically for nothing.

The idea was promulgated in America a few years ago and lately has been touted anew. But the scheme is as old as our pioneering ancestors. Houses of our Revolutionary period yet standing have wood or stone-faced walls with an inner lining of clay mixed with chopped straw, sometimes alternate layers of straw and clay. Such walls are sixteen inches to two feet thick, and, because of thickness and the insulating properties of earth and straw, they are equally proof against heat and cold.

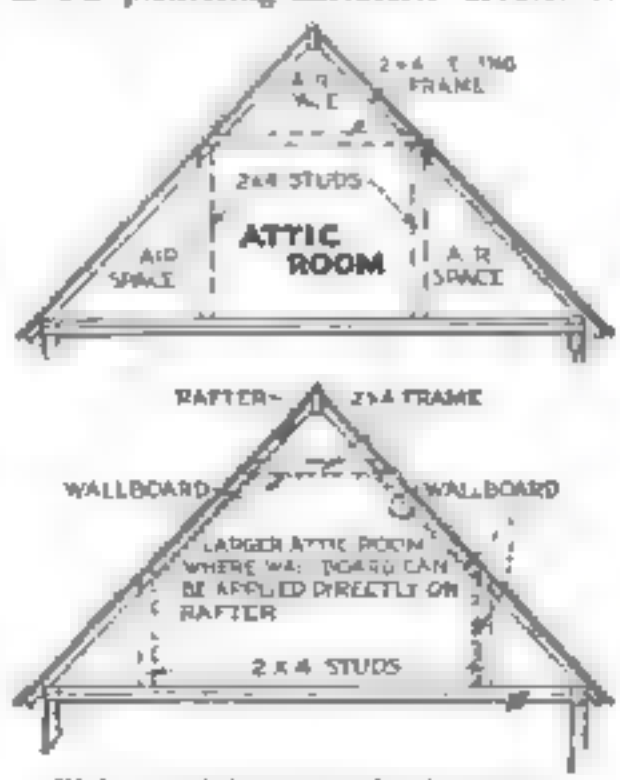
In the arid regions of the United States rammed earth or adobe may be more or less satisfactory. Elsewhere there are disadvantages, including dampness and the invitation to rats, mice and insects. The labor cost is high. The bloated thickness of walls cuts out light at the windows. Altogether, rammed earth seems to me a reactionary and backstepping notion, about like the advice to give up the automobile and return to the buggy. For those anxious to economize and willing to work there are many resources in modern house materials and methods.

A log house is out of the picture for most persons. It takes much labor. To line it neatly with slabs is a job equal to building two regular dwellings.

To consider some other questions readers have asked

Doesn't a dirt floor in a cellar save cement and make a good place to keep vegetables?

MANY used to think so a few decades back, but now our vegetables are kept in cans or in a small storage compartment. A dirt floor emits dampness that molds or rots the wood joists and boards above. It makes for the tracking of dirt and germs into the living quarters. It smells. It becomes a mud floor in wet weather, if not a



With a wood shingle roof build attic room as in upper sketch to preserve ventilation. Lower sketch shows the method to be used with other roofs also old wood shingle if covered with new impervious material

swimming pool for frogs and a breeding place for mosquitoes. It gives easy access to rats and provides cosy winter quarters for snakes. The answer is, use cement.

Besides, we have an important reason lately supplied by Government scientists. They have discovered that great havoc is being done to the lower woodwork of dwellings, including posts, sills, door frames, porch and other floors, by insects commonly termed white ants. These pests must have contact with damp earth in order to live. They boil tunnels beneath, and within woodwork eat nothing is left but a thin shell which some day may suddenly collapse.

The simple checkmate for the criminal white ants is to cut their line of travel between earth and wood with a dry impervious barrier of first-class concrete.

What do you call first-class concrete?

MATERIAL that is not loose and porous even in floor base or inside foundation wall. There should be a well-tamped mixture of one part cement, three parts sand and five parts crushed stone or gravel. Old foundation walls of masonry with lime mortar are likely to have cracks and crevices favorable to white ants. Such walls should be plastered on both sides with a rich Portland cement mixture one inch thick, and extra care given toward making the upper two feet dampproof and insect-tight. To accomplish the latter in some instances means complete replacement of the upper foundations, whether by lifting the house or otherwise.

Sometimes new concrete work that looks first class embodies the serious defect that wood posts or floor sleepers extend through the material to make contact with earth or a porous base of rough concrete or an underfill of cinders. This gives a chance for ordinary decay as well as insects. Insulate the bottoms of posts and sleepers with a good roof cement mixture. It is also well to paint the bottom of such timbers with two brush coats of hot creosote. Where a door frame or post is attacked, cut out the infested part and replace with concrete. Reinforce with wire mesh or iron rods if necessary.

Are there other wood enemies besides white ants?

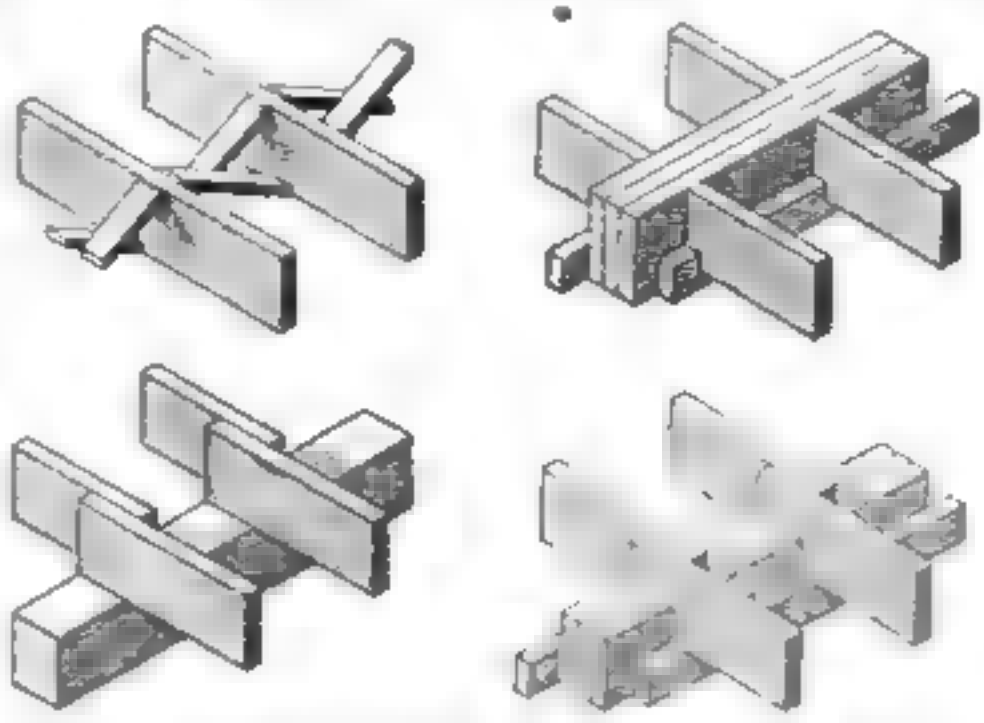
YES, the powder-post beetles who played spooks in a reader's house by tick-ticking in the rafters. They do their worst work in a humid cellar and do not touch wood that has been painted, oiled, waxed or varnished. However they may find untreated rafters or joists to their taste. As their name indicates, they turn wood into powder. We recognize them by their dusty trails and burrows, and shotgun holes at the surface.

These insects may be killed by mopping or spraying infested wood with a chemical which is called by the lengthy name of orthodichlorobenzene.

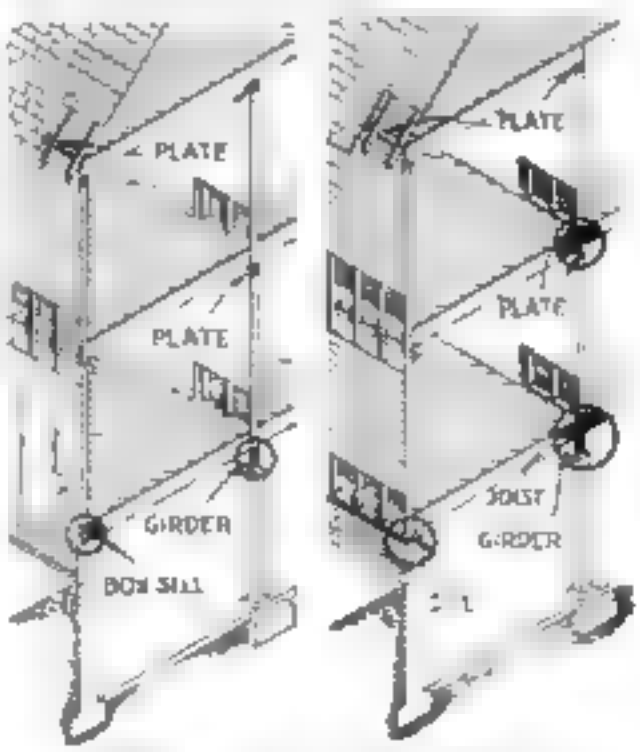
What is the value of red cedar as a moth preventive?

NOT much when used as closet lining, according to Government scientists. The odor in this case becomes too diluted with air. A tight chest made of the heartwood of Virginia or Eastern red cedar kills the young moths and worms but not the mature specimens. Complete protection is obtained with a tight chest of any wood in which you place naphthalene flakes or moth balls, so-called, at the rate of one pound to six or ten cubic feet of space.

Moths may be quickly gassed out of existence, most safely by carbon tetrachloride at the rate of nine tablespoonfuls for a trunk of three cubic feet for an ordinary closet. It is worth knowing that cold storage of the usual kind does not kill moths but merely causes them to hibernate, so that after months of refrigeration they may resume activity.



Construction details of a frame house: Upper left, cross bridging between joists; upper and lower right, two methods of girder construction used to equalize shrinkage of the frame; lower left, joists lapped on top of girder



A building framed as at left will settle evenly, avoiding plaster cracks and uneven floors. Avoid faults of dwelling at right, which will in time settle more in the center than at the walls, because of the crosswise shrinkage of the floor joints, upon which rest the first and second story partitions

These statements are backed by the Bureau of Entomology of the Government agriculture department and may be considered to supersede tradition and the views of Pliny. Sunlight, beating and brushing of clothes are still useful in the everlasting campaign against moths. This is the time to get ready for the warm weather engagement, the sharpest of the year. Look for the hidden enemy under carpets and in furniture.

Is it well to board or line the underside of a wood shingle roof?

THIS is a frequent inquiry from those who plan an extra room in the attic or merely wish to shut out the drafty airs, cold and heat, that pass through such a roof covering. Wood shingles are directly nailed to narrow boards or to so-called shingle lath spaced four inches or so apart, which cross the rafters at right angles. The object of the space between lath is to ventilate the under side of shingles and to let them dry after being rain-soaked, otherwise they would mold and rot. Therefore if tight boarding or lining beneath covers ventilation, it is undesirable.

There are two ways around the difficulty. Cover the wood shingles with a new roof of asphalt, asbestos, zinc or copper shingles or sheets—material that does not absorb water and protects the underlying wood layer from dampness. In this case the roof is made quite air-tight and is also well insulated, and lining may be applied to the rafters to form an extra room or two.

But if you do not want to recover or replace wood shingles, then frame the attic rooms with two-by-four studs and ceiling members so that an air space will be left on all sides. This will naturally cut down the dimensions of the rooms dependent on the roof pitch in amount compared with the other method where all the space is usable. Any kind of lining from fiber board to wood sheathing and gypsum wallboard may be applied to the inside of these attic rooms. They will be snug and useful chambers. And despite the liberal spaces about them, their construction will check many vagrant drafts through the roof.

Is it better to have an exposed chimney or one built within a house?

THE only argument for an exposed chimney is looks, and often that is debatable. There is a lot of misplaced style in massive effects and in balancing the ends of a small house with a pair of exposed chimneys when one in the center would be suitable. The exterior chimney wastes a great deal of heat that belongs within the dwelling.

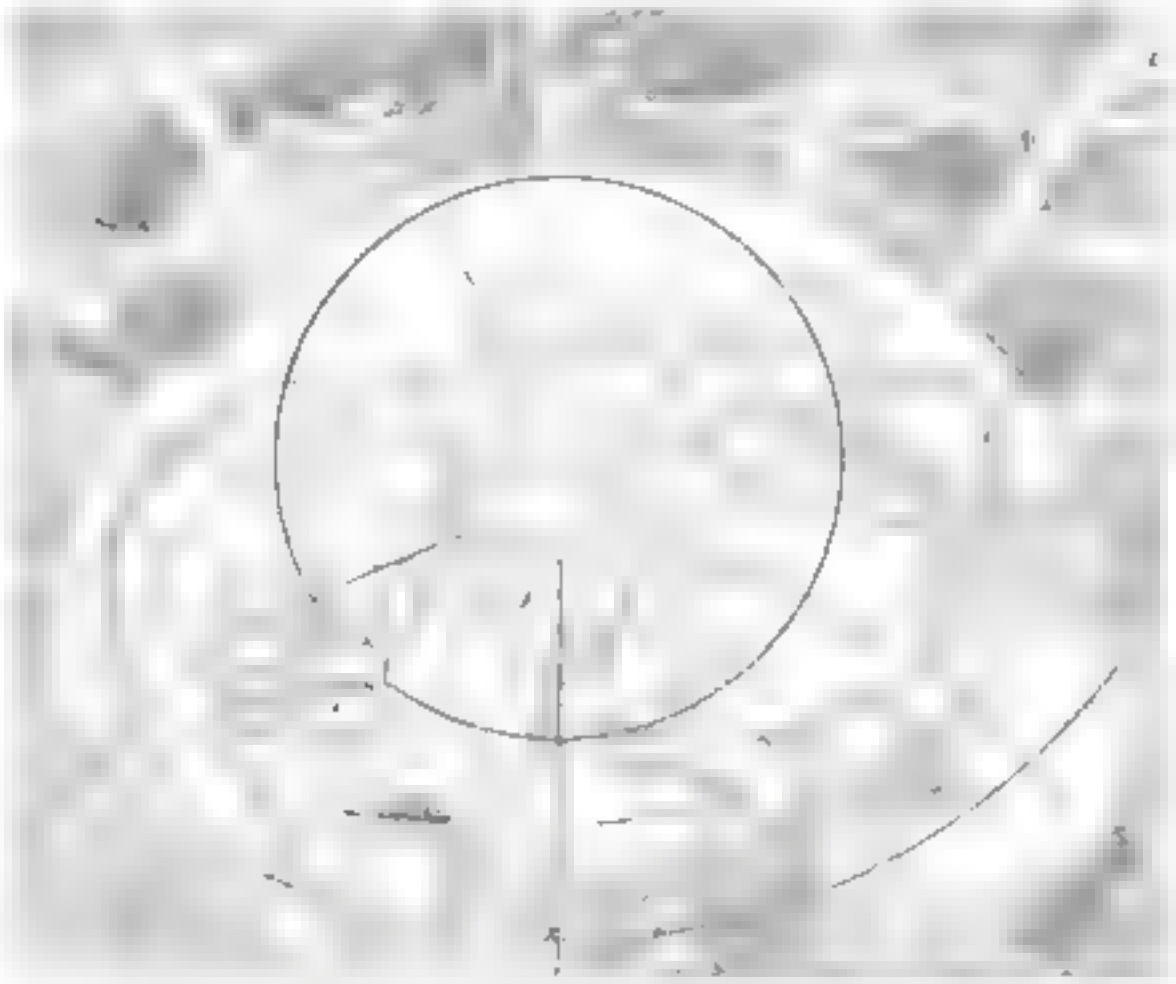
Besides this, the outside chimney is likely to have a poor draft because the hot gases within are chilled and do not travel upward at proper speed. This trouble may be *(Continued on page 150)*

Is Your Yard Yours?

How the "Zero Mark" at Washington Fixes Property Boundaries and Aids Surveyors

By Capt. Edwin T. Pollock, U.S.N.

Superintendent, U. S. Naval Observatory, Washington, D. C.



The starting point for all boundaries in the world is an imaginary point off the African coast. This, in turn, has fixed the starting point for the United States, in the Naval Observatory

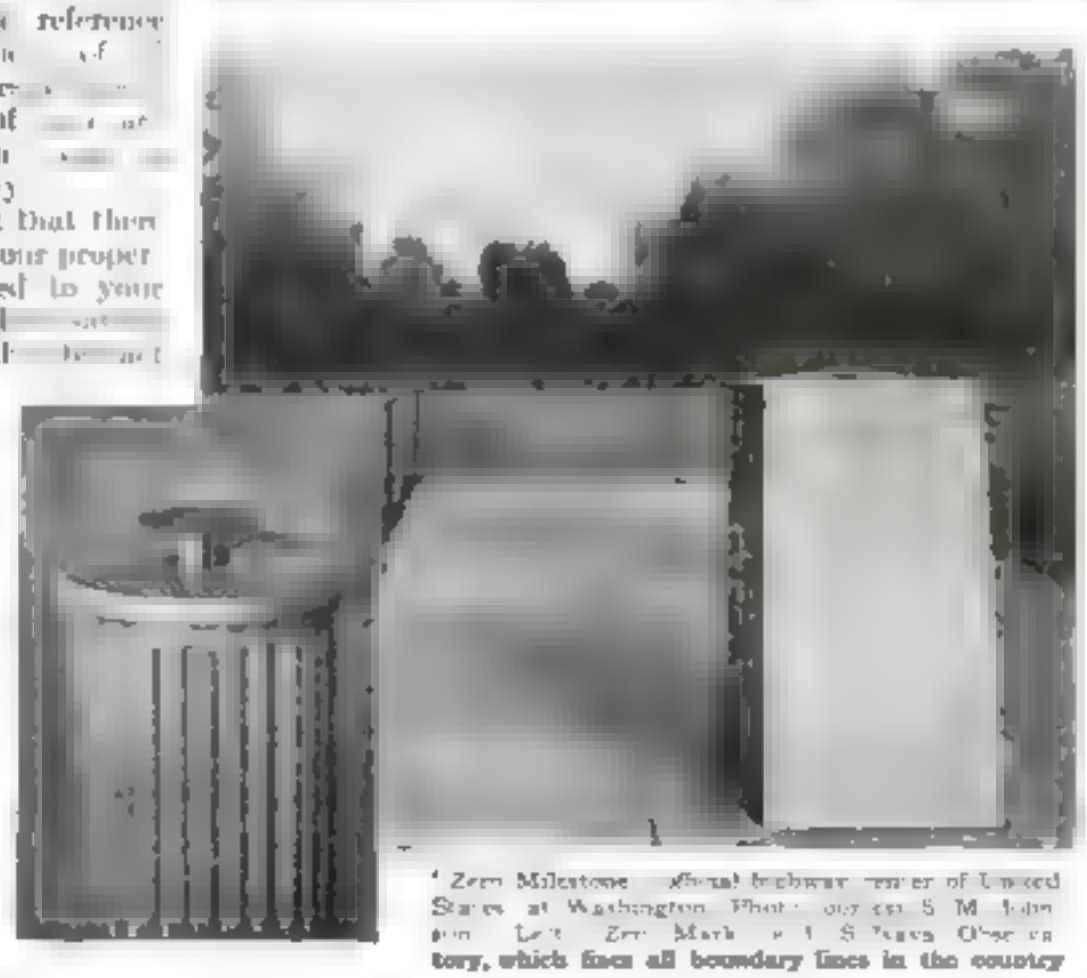
THERE are many "zero marks." A scientist working with temperatures bases his calculations on what he calls "absolute zero," —273.1° centigrade (—459.6° Fahrenheit), a point no one wishes to see or feel; an almost imaginary point where there is an entire absence of heat. Very recently one scientist came close to it and caused helium to freeze at 1.5° absolute.

A traveler starting from the capital of the United States will find back of the White House another kind of "zero mark" one which, by Act of Congress, is the starting point of the entire land system of the United States. It is a small monument. On its top is a bronze casting with compass points and figures giving its location: "Lat. 38° 53' 42.97" long. 77° 02' 14.99" above Potomac level 28.65." At this point azimuths found for California set their spectrometers at zero before speeding away.

In Washington, likewise, is a third kind of zero mark one which, perhaps, is of more immediate importance to you than any other, for it is the reference mark from which the location of places in the nation are established. From it your real estate, if you are fortunate enough to own an estate, is located with scientific accuracy.

Did you ever stop to think that there is an absolute zero mark for your property? Probably not. The deed to your land generally tells you enough to convince you that you own it, even if the boundary of the title shows that it originates at a boundary oak, standing upon a stony knoll, by an Indian path near the head of a deep run which falls into the river, about two miles below the first falls, etc. The tree and path have long since disappeared, but the property is recognized as yours. Still, just *where* is it?

IF YOU should set out to find a definite point by which to locate it, you would first come to the "zero mark" in Washington, mentioned above. That point, you would discover, itself has been fixed by reference to an absolute zero mark from which are located all the zero marks in addition, mentioned above. That point, you would discover itself has been fixed by reference to an absolute zero mark from which are located all the zero marks in all the countries of the world. No one ever has seen this absolute zero, for the reason that it is an imaginary mark lying at the intersection of two imaginary lines the Greenwich meridian and the equator. Moreover, this imaginary intersection is in the Atlantic Ocean, in the Gulf of Guinea off the west coast of Africa.



"Zero Milestone" official highway center of United States at Washington. Photo by courtesy S. M. Johnson. Left: Zero Mark of U. S. Naval Observatory, which fixes all boundary lines in the country

SO IT is that the corner stakes marking your plot of ground are fixed, in the last analysis, by an imaginary point on the ocean thousands of miles away.

In the early days the boundaries of all countries usually were fixed by mountain ranges or waterways, for no one knew a better way and such limits were easily recognized. Even today, in the United States, all but four of the states use water-

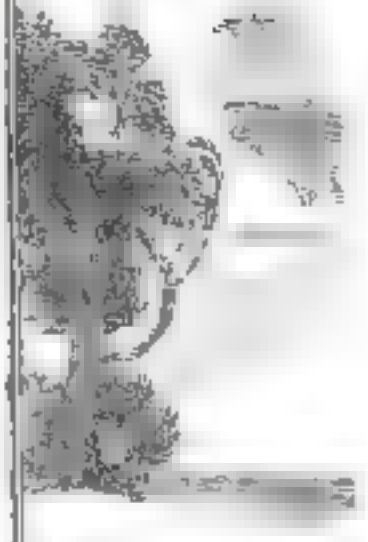
(Continued on page 144)

Bare Hands

A fascinating novel of science, adventure and ingenuity—From the Stone Age to Civilization

By HAWTHORNE DANIEL

Illustrated by J. Clinton Shepherd



ON A pleasure cruise among the Aleutian Islands, Parker and Thornton, partners in a Seattle engineering firm; Williams, a young naval architect, and Kelly, a deck hand, fell into the clutches of Kiska Joe, murderous half-breed seal poacher. Kiska Joe imprisoned them in their own yawl, placed Oomak and two other native Aleuts in charge of the yacht, then returned to his schooner. The two ships sailed westward. When the yawl was wrecked on the rocks, the yachtsmen and Oomak escaped to the beach of a desolate island. Plunged from civilization back to the Stone Age, they built a fire without matches, found shelter in a cave, caught birds for food, and made clothing of rabbit skins. Oomak called the place Devil Island. He said it was inhabited by devils whom Kiska Joe occasionally appeased with gifts. Suddenly the castaways heard a weird, dreadful cry, but could find no trace of what had made it. In a search of the island Kelly discovered a deposit of magnetite ore. Thornton's suggestion that they attempt to smelt it and make metal tools was ridiculed by Parker, nevertheless Thornton devised a blast furnace with rabbit skin bellows, and fashioned molds in the sand for a hammer, axe and adze. The result—tools of steel! Now read on

KISKA JOE'S plans had gone rather badly astray. Oomak had had definite instructions as to what to do with the yacht, but once the fog had come up she had disappeared. There had been no storm, and the yawl could not have been driven out of her way. Oomak knew the destination, which was another uninhabited island a hundred miles or more beyond Devil Island, past which Kiska Joe had sailed early on the morning after the night of fog. It did not occur to him for a week that the yawl might have run aground, but he did think of a hundred possible ways in which the yachtsmen might have overpowered or bribed the three men he had placed over them as guards.

He wondered where the yacht might have gone. She might well have returned to Kiska in order to report the affair to the Coast Guard, in which case Kiska Joe had need to watch his step. Or, possibly the yachtsmen might have made their way to some other harbor in the Aleutians, or might even have headed back to Seward or Sitka or Seattle. In that case, they undoubtedly would get in touch with the Coast Guard by radio, and still Kiska Joe had need to be careful.

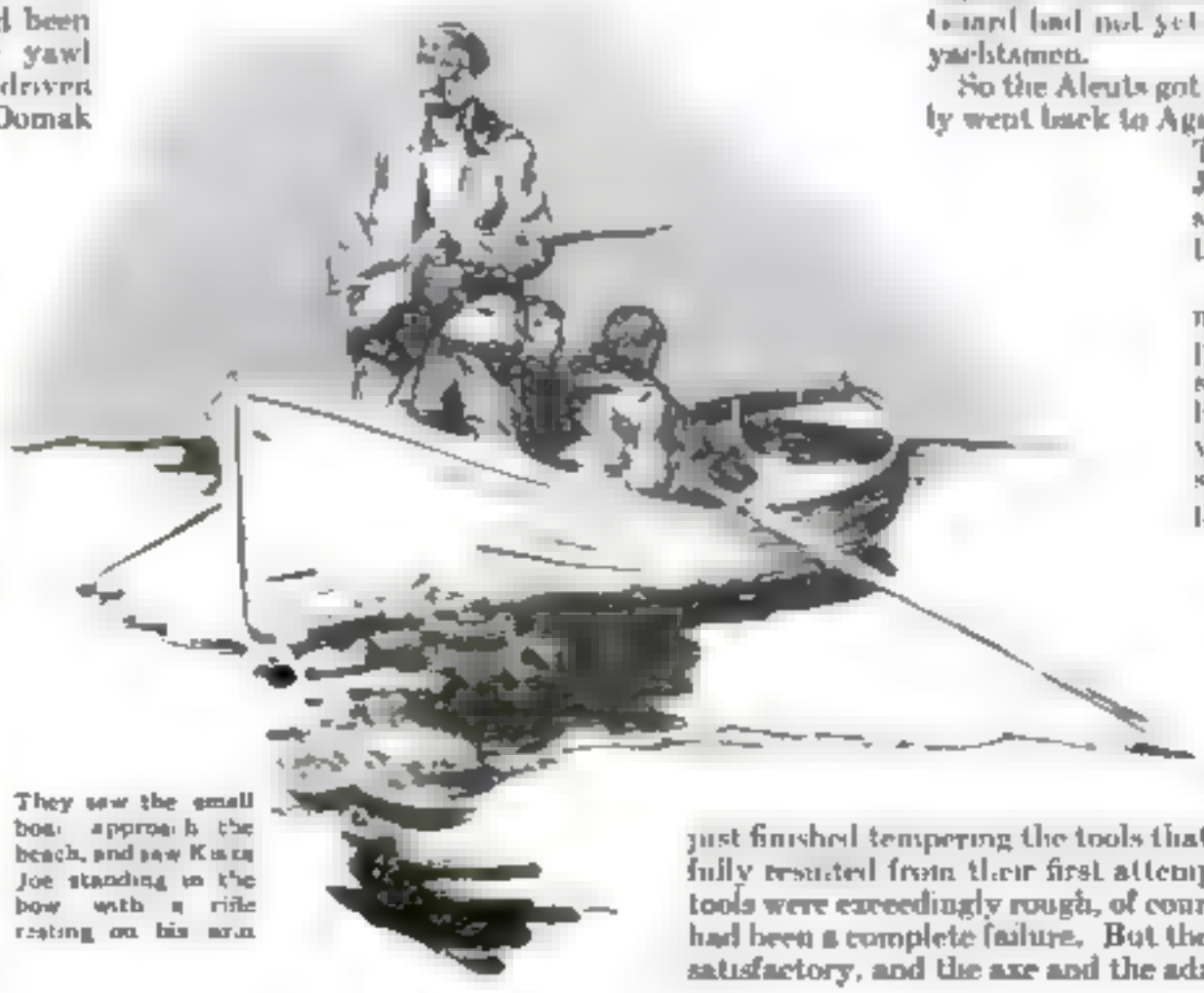
A wreck seemed inconceivable to him, for he had a sailor's intuition, and without a storm to upset his rough calculations, he always felt himself perfectly safe at sea. And there had been no storm. Still, it was possible that the yacht had gone aground on Devil Island during the fog, and he decided not to investigate. But he decided to mend his fences before looking in at that desolate spot. He made his way to an unfrequented anchorage off the island of Agattu. From there he sent two Aleuts from his crew to Kiska, where they appeared in a small boat ten days or so after the yawl had sailed for Buldir Island.

The two visitors dared not inquire directly, and so pretended to have other business, and kept their eyes and ears open. The Coast Guard cutter was anchored serenely as if nothing had happened. No one ashore knew anything unusual, for several times the yachtsmen were mentioned, and it seemed to be common knowledge that they had gone to Buldir and had planned to continue their cruise on to the west for two or three weeks before returning directly to Seattle. Obviously nothing had come to the ears of anyone ashore, and apparently the Coast Guard had not yet begun to worry over the yachtsmen.

So the Aleuts got out their boat and blithely went back to Agattu to make their report.

Thus it was that Kiska Joe finally set sail a second time in the direction of Devil Island.

On the island, in the meantime, the days had passed very slowly. The shipwrecked men had not been there, actually, so very long. But already it seemed as if months had passed. Of course, they were in possession of fire, and shelter such as it was. They had food, but already it was extremely monotonous. They had clothing, but it was crude, even though warm, and they had just finished tempering the tools that had more or less successfully resulted from their first attempt to smelt iron ore. The tools were exceedingly rough, of course, and the small hammer had been a complete failure. But the larger hammer was quite satisfactory, and the axe and the adze had finally been beaten



They saw the small boat approach the beach, and saw Kiska Joe standing in the bow with a rifle resting on his arm

There on the beach stood the pathetic group, small and defenseless amid the immensity of sea and rocks and sky. They covered the pitiful form with sand, and marked the spot with a wooden cross

into shape and rubbed up. They had been tempered, and had acquired edges that were reputable enough, for Williams and Kelly had spent the whole of one day sharpening them on a slab of sandstone they had found.

Thus it was that by the time Kuka Joe finally sailed from Agattu, the three steel tools were mounted with sturdy handles, and were ready for the work that would begin seriously on the morrow.

"Pretty slow work," remarked Thornton as they sat about the fire in front of their cave and chewed at the meal that Oomak, who had come to be the cook, had prepared. Fish and ptarmigan, smoked rabbit and eggs boiled in a little pool by dropping hot stones in the water, made up the menu.

"DISGUSTING food!" complained Parker. "I wish I had a cigarette. Haven't gone so long without a smoke in years. Nuisance!"

A strong wind was blowing, and the sea had risen considerably, until the water washed up the beach to within a few yards of them, and from time to time a little spray moistened their faces. Farther up toward the cliff stood the blast furnace, cold now, but sturdy, and protected from the sea by the very rock in which lay their shallow cave.

The wind blew the camp fire and scattered sparks about, and the party huddled back into the cave to get out of the rising wind.

Williams looked out toward the darkening sea. Whitecaps dotted it as far as he could see in the dim light of evening, and the surf was pounding in on the beach in a gradually rising series of roars.

"Well," he remarked, "We are likely to get wet here tonight."

"You think the surf will get up this far?" asked Thornton.

"It has come more than halfway already."

"Then we'd better move back, hadn't we?"

"Nuisance," muttered Parker. "Do you suppose we have to?"

A feather of spray, heavier than before, spattered against the rock before the entrance to the cave, and some of the water hissed into the camp fire.

"I guess we must," nodded Kelly. "Here goes."

"Where are you bound?" asked Thornton.

"There's another hole in the rocks up a ways that's just as good as this, and it faces the other way.

How far?"

"Right beside the stream where it comes out of the ravine."

The party got to their feet with Parker still muttering "Nuisance!" and began to carry their belongings toward the spot to which Kelly led them. A fire was built from brands carried from their cave fire, and within half an hour they were moved and settled, with their moss and grass beds once more ready for them, with their tools and smoked meat, their extra rabbit skins, and the few bark utensils that Oomak had made. Certainly it was more comfortable, for the cave faced away from the wind, and looked, instead, into the black ravine from which poured the stream. Their new fire was protected, too, and the cave was, if anything, a slight improvement over the one they had been using.

They sat down again when their simple task was done, and listened to the still rising wind.

"Guess we'd better fix this place up a bit before we try anything else," remarked Williams. "It'll take some time to build a boat."

"We can make a log front for the cave," added Thornton, "and can make a table and a bench or two. Then we'll be set to begin."

"BEGIN!" snorted Parker, who had not, as yet, done a stroke of work. "You talk as if you thought you would be here long enough to build a boat. If you would listen to me and make some plans for a lookout and a signal tower you would be doing something useful. Build a boat! Tommyrot. It would take you months and we might sight a ship any day."

Williams, who in Seattle had always looked upon Parker as a very important person, could hold in no longer. He had stood for the engineer's constant opposition and nagging and had held his tongue. But this was too much.

"Why don't you sing a new song?" he demanded. "You haven't done a thing since we've been here but kick. If you want a signal tower, build it yourself. And a lot of good it will do you. A ship doesn't sail in these waters once in a blue moon. Do you know where we are? We're nearer Asia than Alaska. We're two hundred miles, at least, north of the trans-Pacific routes. Ships to Nome sail a route nearly a thousand miles from here, and the very land we're on may be Russian territory, for all we know. If it is, it isn't likely to be visited from one year's end to the next. There are no seals here to speak of, so poachers aren't likely to come, and who else has any interest in such a

God-forsaken spot? Use your brains and you'll see that there isn't any chance of a ship appearing in a year. Forget your ships, or if you want to watch for 'em, do something else beside grouse."

Parker did not answer. The fact that ships were so rare in the sea surrounding their island seemed to make a new and profound impression on him. Perhaps, he thought, he had been wrong. Perhaps he had better try to do his share of the work as the others planned it. Already they had done things that he had not thought possible. Yes. He would try.

"Well," he announced at last. "Maybe you're right and I'm wrong."

Then he stopped, for he had not meant to go so far. "But I don't believe it," he continued. "It seems to me you are going to a lot of hard and unnecessary work. But I'm in the minority, so I'll try following your plans for awhile. If you are going to fix up this place a bit, I'll help. I'll ——" he hesitated, for he didn't know what to do or how to do it. "I'll build," he stumbled, still wondering what he'd build. "I'll build a fireplace." He finished suddenly, surprised that he should have hit upon such a thing.

THORNTON was pleased. For Parker had been his principal worry. If he would do anything, no matter how badly, the situation would improve.

"Fine," he remarked. "Fine. It would help a lot."

Williams grunted disrespectfully and rolled over in his grass bed.

"I'm going to sleep," he muttered. "Tired."

Outside the mouth of the cave the fire blazed bravely, and Thornton fed it with pieces of wood that he had proudly split from a fallen tree with the axe that had been sharpened two or three hours before. Rain was beginning to fall, and he sat down to watch the fire.

"Go to sleep," he said to the others over his shoulder. "I'll watch the fire for awhile."

As Thornton sat listening to the growing roar of the surf and the singing of the wind he began to ponder how they might escape from the island. A boat, certainly. But there were more difficulties than he had thought. According to Williams, they must be two or three hundred miles from any inhabited land. And there were five of them. It would take a good-sized boat, and they would be unable to build any sort of boat that was not heavy. In addition Williams had said that the prevailing wind was in the wrong direction, and that a strong current flowed to the westward out of Bering Sea toward the coast of Kamchatka. That was no good place to go, for not only was it thousands of miles from civilization, it was also Siberia, where more than one American already had experienced trouble with commissars and such. No, they should go the other way, and yet they never would be able to row so heavy a boat as they would have to build, or at least Jorx never could row it across three hundred miles of open sea given to storms, and against the prevailing wind and current.

SAILS, of course they might make—but out of what? Rabbit skins? No. There would be hardly enough rabbits on the island. It had taken nearly three hundred to get them along thus far. He figured it out in his head. A rabbit skin was, roughly, eight inches by twelve; say one hundred square inches. Williams had said they probably would need a thousand square feet of sail. That would mean 1440 skins. Sealskins? They would be fine, but since landing on the island they had seen only one seal and had killed none at all. And to make sails of sealskins they would need a hundred. They never could get that many of the skins. He shook his head and turned his mind to other things, and after three hours of watching the fire, he called Williams to relieve him, then turned in and went to sleep.

The storm was still blowing in the morning, and they were glad they had moved, for the sea was washing up almost to the very mouth of the cave they had left. They ate breakfast and decided that the day would be well spent if they devoted it to fitting up their new abode.

OOMAK went out with his spear to get some fish. Parker set about gathering stones—most deliberately, for his fireplace, and Kelly, remembering that he had left a shapeless hut of metal in the other cave, went out to get it. Thornton and Williams set out up the ravine to cut some trees, and had gone hardly more than a stone's throw away when they heard Kelly cry out.

"Hey!" he shouted, waving to them. He was standing near the cave they had left the night before. They turned and walked toward him.

"There's a dead man here!" shouted Kelly.

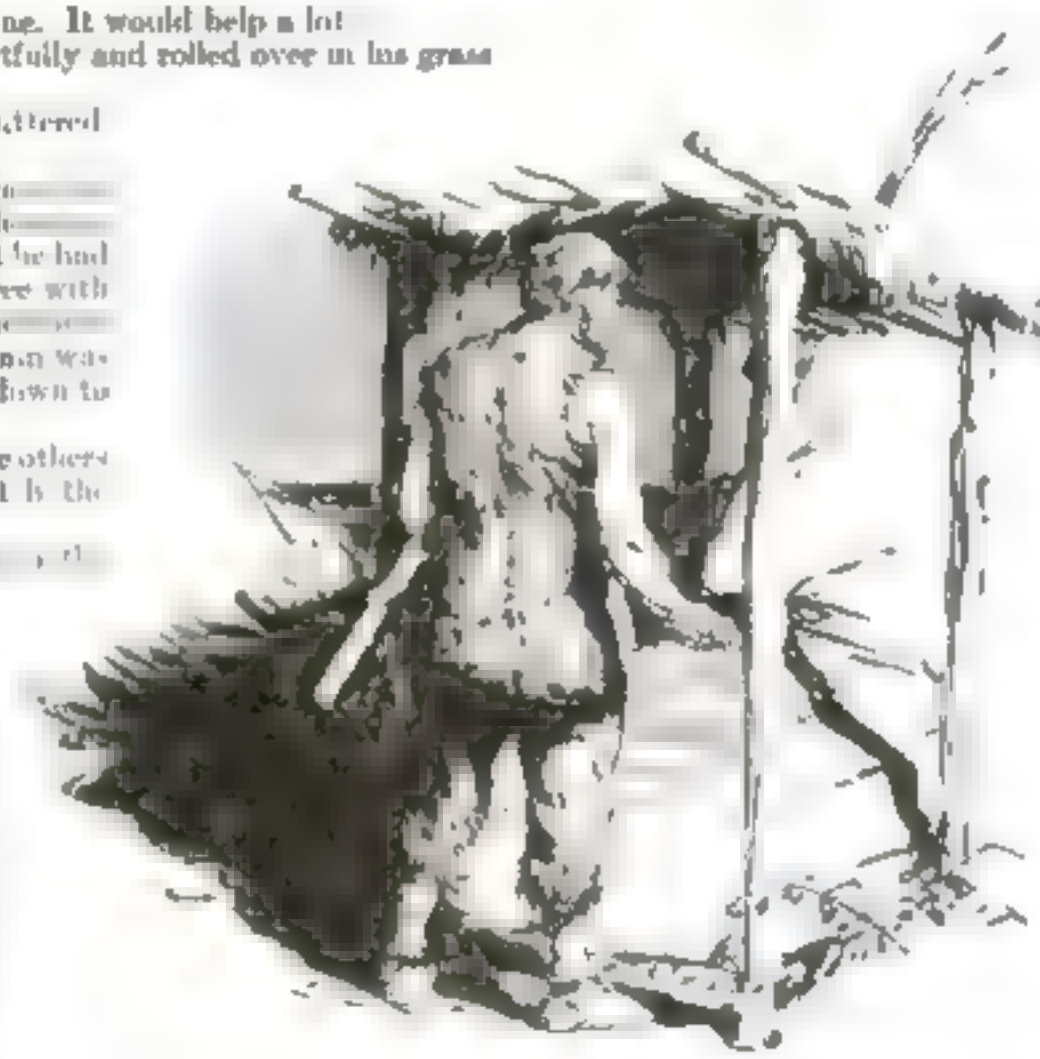
"A dead man?" repeated Williams as they approached. "Where?"

"In the cave."

"Let's look," said Thornton. How had a dead man come to be on the island at all, much less in the very cave they had left only the evening before?

They made their way into the deserted cave. There an Aleut, dead and staring, leaned against a rock that thrust itself out from the side wall. His clothes, which were water-stained and sandy, unmistakably had originated with some trader. There was nothing else to identify him. The dead man sat almost as if alive, save for his pitiful expression, his partly open mouth, and his open, sightless eyes.

"How did he get here?" asked Williams. "Who is he?"



Williams drew the plans for the boat on a large, smooth rock, then erected a protecting thatch to keep the rain from washing them away

THORNTON examined the sand before the cave, but could find no marks save those left by the heavy raindrops of the night before. Within the cave, however, he saw two deep grooves in the sand. They ended at the dead man's heels. Beside the grooves were oval dents—footprints, obviously.

"Someone dragged him in here last night," he announced.

"What do you mean?"

"Look! The footprints! We didn't make them. You can tell ours from the marks made by the bark soles. Someone else did that. By George, Williams, there's somebody on this island beside ourselves."

The desolation of the island was a fitting background for the little group of men as they carried the body of the Aleut out and placed it in a shallow grave in the sand. Overhead the sea gulls glided, squawking drearily now and then. The surf pounded in on the beach in a dirgelike monotone. High on the cliff the misshapen trees waved their arms as if bewailing the departed soul, and there on the beach stood the pathetic group, small and defenseless amid the immensity of sea and rocks and sky.

They stood reverently about the grave for a moment, and then, as gently as they could, covered the pitiful form with sand, and marked the spot with a wooden cross.

Before they had removed the body from the cave they had called Oomak. After much persuasion he had entered, but when he saw the dead man's face he shrank back.

"Tugmak," he muttered. "Tugmak."

"You know him?" asked Thornton.

"Tugmak," he nodded. "Him with

(Continued on page 118)

Don't Fall *for* "Bargain" Tubes

I Did Once and Found That, Though They Made a Fine Test in the Store, in the End They W'ere an Expensive Luxury

As told to NEWTON BURKE

THE clerk that I made out to pay for our new radio outfit put quite a dent in my bankroll but the wife and I both agreed it was worth it. The set worked fine, and in fact we found that, while it had cost us a lot of money, it promoted economy in other ways. We stayed home evenings and listened to the radio instead of going out to the movies or more expensive shows.

"John," said Mildred one evening, after we'd had the radio several months, "it seems to me the broadcasting doesn't come in as loud as it did, and even the tone quality is getting poor. Are you sure the batteries are all right?"

"I tested them last night," I replied. "The storage battery is in good shape or my hydrometer is a liar, and you know I put in new B batteries not over two weeks ago. It doesn't sound right, though I'll admit. I wonder if the tubes are going bad? Maybe you'd better stop in the store tomorrow and get a couple of new ones."

My wife has just one bad habit—she's a confirmed bargain hunter. Lots of times she'll come home with an armful of truck that we really don't need just because she ran across some "perfectly wonderful" bargains.

The next night when I got home she proudly handed me a small package.

"For once you'll have to admit that I got a real bargain," she began. "While I was at marketing I saw a sign in the window of a radio store offering to exchange new tubes for old ones and fifty cents, so I went right home, took two of the tubes out of the set and brought them back to the store. He gave me two new ones, and here they are. Aren't you proud of me?"

"I'LL see how they work first," I replied, hoping that by good luck she had traded in the bad tubes—if there really were any.

The new tubes came in flossy little packages packed with a circular that told what marvelous tubes they were. I stuck them in the sockets and turned on the juice. The station that happened to be tuned came blaring out of the loudspeaker and we [illegible] when the music suddenly stopped all over. I saw flashed up as bright as arc lights and then went out.

"What on earth happened?" gasped Mildred.

"How should I know?" I growled impatiently. "Looks as if there's no more radio for us tonight anyway. Maybe the battery connections got crossed all of a sudden. I'll look them over again."

However, I couldn't find anything wrong, so the next day my wife took all the burned out tubes and traded them for another set at a cost of $2.50, or only a little more than the price of one standard tube. I was rather short at the time and hated to have to call in a radio service man.

"Well, whatever was wrong seems to have cured itself," I remarked that evening when we found that the set worked all right with the new tubes. Fifteen minutes later, the music, without warning, quietly faded out. The tubes glowed as bright as ever.

"MAYBE they stopped broadcasting," Mildred suggested brightly, so I tuned-in half a dozen other stations. That is, I turned the dials to the points where they should have come in, but the speaker refused to make a sound.

"It can't be SOS. I guess, let's go to the movies tonight," I said, and we went out and sat through a new reeler. On the way home we met a friend who's a shark at the radio business.

"Too bad that ship was in distress tonight," I said, just to show him I knew a thing or two about radio.

"SOS?" he said questioningly. "Why, there hasn't been any all evening."

"Then I guess it must be my radio that's in distress. Come around and see if you can dope out what's the matter."

I shall never forget the look of supreme contempt that came over my friend's face as he lifted the top of the radio set and saw those tubes the wife had bought.

"Who stuck you for the ten-cent glass-[illegible]" he asked. I told him what had happened and he roared uproariously.

"THOSE gyp tubes are practically worthless," he explained. "You might find a halfway good one out of a lot of a hundred. The rest either burn out or give out within such a short time that they're not worth even the fifty cents you pay for them. The dealer just chucks the old tubes you exchange in the mail can with the rest of the trash."

What happened when all our tubes burned out he went on to explain we could blame on one of the gyp tubes we had in the set at the time. Probably the elements in the tube were put in so crooked that the slight expansion from the heat when we turned them on caused a short circuit between the plate and the end of the filament which burned the high voltage from the B-battery directly through the filaments of all the tubes and blew them all out. The defective tube must have been in one of the radio-frequency stages, otherwise the high resistance in the (Continued on page 148)

Trifles That Count *in* Radio

How to Check Up on Possible Weak Points in Your Antenna, Tubes, Wiring and Loudspeaker

By
ALFRED P. LANE

Your dealer will be glad to test tubes for you or you can do it yourself with a combination tube tester and rejuvenator such as is shown here

YOUR radio receiving equipment is like a chain. It is no stronger than its weakest link. And there are possible chances for defective links in the path of incoming signals all the way from the end of the antenna to the loudspeaker. At every step the radio signal follows the proper path only when it is forced into it. If there is a chance for any of the electrical energy to dodge work and sneak around any piece of apparatus instead of going through the windings, you may rest assured that it will do so. Consequently you must guard against even a single defective link in the entire chain of your radio reception.

Knowing where trouble is most likely to occur will help you to install your radio set so as to minimize the possibility of future difficulties, and will help you to overcome them when you suddenly discover that your radio reception is beset with mysterious noises, ear-piercing squeals or loss of volume.

The first link in your radio chain is your antenna system. Defects at this point may cause all sorts of queer noises, weak signals or no signals at all. If, for instance, you have not soldered the joint between the antenna and the lead-in wire, although reception may be excellent for months, corrosion will work into the joint and the increase in resistance will cut down the signal strength, then, if the joint works loose, the signals will be irregular and accompanied by scratchy noises.

OR YOUR antenna insulators may cause trouble. Any good antenna insulator retains its insulating properties almost indefinitely, but if enough soot and dirt collects on them, there will be a falling off in volume, particularly during damp, rainy weather, because the radio waves quite naturally will take the short path to ground offered by the coating of dirt rather than go through the longer path in your radio set.

Another source of trouble in your antenna system that often fools even the expert radio man is the lightning arrester. After a summer season during which there have been a number of violent electrical storms, it may be found that the lightning arrester is causing a noticeable loss in signal strength. The constant snapping of electric sparks across the tiny gap in the insulator corrodes the surface, and minute particles of the metal are deposited at the sides of the gap to form an easy path to ground for the radio waves.

THE test for a defective lightning arrester is to tune the set to a weak station and disconnect the ground wire on the arrester long enough to find out if the volume is increased. If the arrester is reducing the strength of the signals, replace it with a new one.

Of course, there always is a chance that your antenna may sag and touch some other antenna, or the roof. Usually this condition shows up during a wind storm that sways the wire back and forth.

Once the signals are brought into your set, they may be spoiled by an extremely large number of mechanical and electrical troubles, most of which, fortunately, are rare. In these days of good mechanical construction, variable condensers are so well made that shorted rotor plates or loose rotor shafts are as scarce as teeth in a hen. Fixed condensers, too, give little trouble if they are of high grade.

Tuning coils do not weaken as they grow older. If through some accident in construction, there is a short circuit in a tuning coil, it shows up at once when the coil is first put into service; therefore, if your set has been giving satisfactory service, you needn't worry about short circuits in the tuning coils. If, however, there is a movable coil in the set, there is always a chance that one of the flexible wires leading to the coil may break off.

WHILE early models of audio transformers frequently burned out or short-circuited in use, modern types are so thoroughly insulated that they rarely give trouble, and consequently the audio transformers in your set should be tested only if you can't find the weak link anywhere else.

Of all the parts that go to make up the receiving set, the tube sockets are most likely to cause poor reception. The spring contacts that should press tightly against the prongs of the vacuum tubes often become bent or corroded. One poor contact among all the sockets in your set may cause scratching and grinding noises that are most annoying to the ear.

The mere fact that all the tubes light is no proof that nothing is wrong with the sockets, because it may be a grid or plate contact that is bad. If even one contact spring fails to touch the tube prong with which it is supposed to make connection, your reception will stop entirely.

The latest types of vacuum tube sockets make contact with the sides of the tube prongs, and consequently it is a mighty good idea to sandpaper the sides of the prongs every few months.

Five Rules for Good Reception

1. **Make sure that your radio equipment is carefully installed.**
2. **Tighten all connections regularly.**
3. **Keep storage battery clean, charged and filled with distilled water.**
4. **Check the voltage of your B-batteries.**
5. **Have your vacuum tubes tested at the first sign of weak reception.**

The vacuum tubes are the vital links in the chain of good reception. All of the other parts in the receiver are merely accessories to enable the vacuum tubes to function properly. Moreover, the vacuum tubes are the only parts in your set that are sure to lose their useful qualities in due course of time.

AFTER from one to two thousand hours of use, the tube goes dead. This means that the stream of electrons sent out by the filament decreases in volume to the point where it no longer is capable of giving proper results. The mere fact that the tube still lights as usual proves nothing. Most tubes go dead before the filament burns out.

It is a good idea to have your tubes tested every few months to see if they are beginning to fall off in efficiency. If you want to make the test yourself, a tube tester can be purchased that will tell at a glance just how good your tube is. By throwing the lever to the other side, the tube can be rejuvenated if it is not completely exhausted.

A famous general once said that an army travels on its stomach. It is equally certain that a radio set is absolutely dependent on its power supply for good results. Perhaps ninety percent of the trouble with radio receivers can be traced directly to current failure.

When your current supply fails, the difficulty always can be found either in the batteries themselves or in the wires that carry the current to the receiver. Electric current can not flow unimpeded through a corroded or loose connection, so make sure when you install your radio set that all connections are tight. Check them at least every two or three months, paying particular attention to the storage battery wires that supply the A-current to the set. These are especially important because the voltage is low, and because no matter how carefully a storage battery is constructed there is sure to be some acid seepage that in time will corrode the joint between the wire and the battery terminal.

MAKE sure that your storage A-battery is charged at regular intervals, or keep it charged full all the time with a trickle charger. Don't be afraid of overcharging a storage battery. Most storage batteries in radio use suffer from insufficient charging. Do not neglect to add water whenever the solution level gets down to the point where the separators or plates begin to show. The hydrometer which is used to check the condition of the battery also serves as a syringe with which to add distilled water.

Dry cell B-batteries should be tested once a month, and it will pay you to discard them as soon as the voltage of any forty-five-volt block falls below about thirty-five volts. Occasionally a battery will give good results for a considerable period of time after the voltage has fallen below the figure mentioned, but reception is likely to be noisy. In addition, batteries that are nearing the end of their useful life are quite likely to give out suddenly and leave you with no current to run your set. This usually happens when you have guests at your house to listen to some important program. Play safe and buy new B-batteries when the voltmeter shows that they are needed.

There is a temptation to connect up a string of old B-batteries in series to make up the required voltage, but good results cannot be obtained in this way. Reception is bound to be extremely noisy and uncertain when such a makeshift is used.

Storage battery connections should be watched carefully. Clean and tighten them frequently

Use the hydrometer to add distilled water whenever the solution level gets too low

A voltmeter will tell whether B batteries need replacing. It doesn't pay to use them when voltage is too low

The last link in the chain of perfect radio reception is the loudspeaker. A defect anywhere along the line shows up in the results obtainable from the loudspeaker; yet, if your entire installation is perfection itself, you cannot get good reproduction of speech or music if the loudspeaker goes wrong.

For instance, a tiny sliver of steel, so small that you would have difficulty in seeing it with the unaided eye, may get between the pole piece of the loudspeaker and the moving armature or diaphragm and completely ruin the tone quality. Usually this trouble shows up when you try to operate the loudspeaker at loud volume. Sometimes the sliver of steel simply causes chattering on some particular note in the musical scale.

OCCASIONALLY it will cause a rasping chatter on every sound coming out of the loudspeaker. In a cone type speaker, the slightest looseness in the fastening of the paper of the metal disk at the center will cause rattles or chattering noises at some particular frequency.

You may also find that some small article placed near the loudspeaker is being set into vibration by the sound waves. So before you blame your loudspeaker for peculiar rattles, make sure that the trouble is not merely vibrations from some near-by object.

While you probably will have no trouble in fixing a broken wire in the receiver if it is not hard to get at, or in caring for the batteries, do not attempt to make repairs on a loudspeaker. The mechanism is so delicate and the tone quality depends so completely on careful adjustment that repairing should be done only by an expert.

Another often unsuspected source of trouble is the loudspeaker cord. Phone cords and loudspeaker cords ordinarily are made of what is known as "tinsel" wire. Instead of a solid or stranded wire such as is used in electric light drop cord, tinsel wire is used to give extreme flexibility. It is produced by winding a ribbon of metal tinsel about a string.

SUCH wire will stand bending innumerable times without breaking, but it has little tensile strength and consequently is easily broken by a sudden yank. Sometimes the strand of tinsel is broken and the two ends remain in partial contact so that current can flow. But the poor contact changes in resistance whenever the cord is moved and grinding and sizzing noises result.

Because of the small cross-sectional area of the tinsel wire it also is subject to corrosive influences that might not harm a heavier wire. A single drop of acid from the end of the hydrometer, if it happens to drop on the loudspeaker cord, will eventually ruin it.

The test for a defective loudspeaker cord is to disconnect the antenna while the set is in operation and turn the dials so that no station is tuned in. Then go over every inch of the cord and bend it back and forth while you are listening with your ear close to the loudspeaker. You will be able to tell where the trouble is by the noises that result when you twist the cord at the defective point.

Hints for Radio Beginners

When You Use Power Tubes—

An Output Transformer or Filter Will Improve Tone

WHEN you decide to bring your old set up to date by installing modern audio transformers and a power tube in the last stage of audio amplification, remember that, for best results, you must use either an output transformer or a choke and condenser to keep the heavy plate current from the power tube out of the windings of the loudspeaker.

If you use the 171 type power tube in the last stage, these additions to the circuit are absolutely necessary, as otherwise you may burn out the loudspeaker. But it is possible to get along without them if you use either the 112 type tube or the 120 dry cell type power tubes. However, the tone quality is improved if these parts are used with any type of power tube.

In most cases, there isn't room inside the set for the output transformer or the choke and condenser. The drawing on this page shows how to hook up these parts outside the cabinet.

It makes little difference which type of circuit you use. Either an output transformer or a choke and condenser will give excellent results provided you use parts designed for such service.

There are a number of output transformers on the market at the present time that are especially designed to handle the heavy plate current of the 171 type tube. They introduce little additional distortion and are entirely satisfactory. Be sure that you do not become confused between the regular types of audio amplifying transformers and the special types designed particularly for the output circuit.

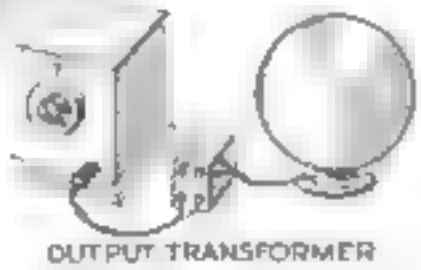
Enormous insulators used by the broadcast station at Rugby, England

The choke and condenser method of dealing with the output plate current is, of course, excellent, for this combination cannot be overloaded by heavy signals and there is no chance of core saturation.

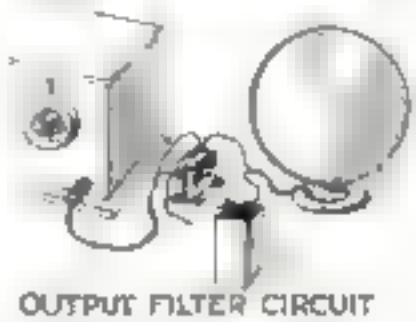
THERE are special types of audio choke coils made for use in the filter circuit shown but any of the choke coils sold for use in constructing B-battery eliminators will give perfect results.

Do not attempt to use the primary or secondary circuit of an ordinary audio amplifying transformer as a choke coil. It will not work. The windings of ordinary audio transformers are not designed to carry the heavy plate current of a power tube.

Experiments at the Popular Science Institute of Standards show that it is desirable to have a large capacity condenser at the point shown in the diagram. Up to about sixteen microfarads may be used with excellent results as far as the low audio tones are concerned. However, it is not necessary to go beyond four microfarads for practical purposes, and the difference between two mfd. and four mfd., while it will show up on sensitive measuring instruments, is not perceptible to the average ear. Be sure that the condenser used has a rated working voltage equal to the plate voltage you apply to the power tube.



OUTPUT TRANSFORMER



OUTPUT FILTER CIRCUIT

Use either an output transformer or an output filter circuit if you install a power tube

When to Use Insulators

THE amount of insulation needed to keep electric current flowing in the correct path depends both on the voltage and on the frequency of the alternation if it happens to be alternating current. Increasing the voltage in any circuit means that more insulation will be required. The same effect is produced by increasing the frequency or rate of alternation. For instance, a circuit that carries current at a pressure of six volts is insulated by the thinnest layer of tissue paper, if it is direct current or alternating current of, say, twenty-five or fifty cycles. But there would be a serious current leakage if the six volt current were of the high frequencies used in radio transmission and reception, where the alternations of current flow go up to 1,500,000 a second at the lower end of the broadcast band of wave lengths.

Of course the voltage of the current received on your radio antenna is comparatively low, but because it is of such high frequency care must be taken to have it properly insulated. As the signals are passed through the detector tube, the frequency is reduced to the audible range, but then as it passes through the audio amplifier end of the set the voltage is greatly increased by the B-battery; so careful insulation is needed at this end of the circuit to prevent losses and damaging short circuits.

In broadcasting and other high powered radio transmitting stations, where both the voltage and the frequency are extremely high, the antenna insulators must be of enormous size.

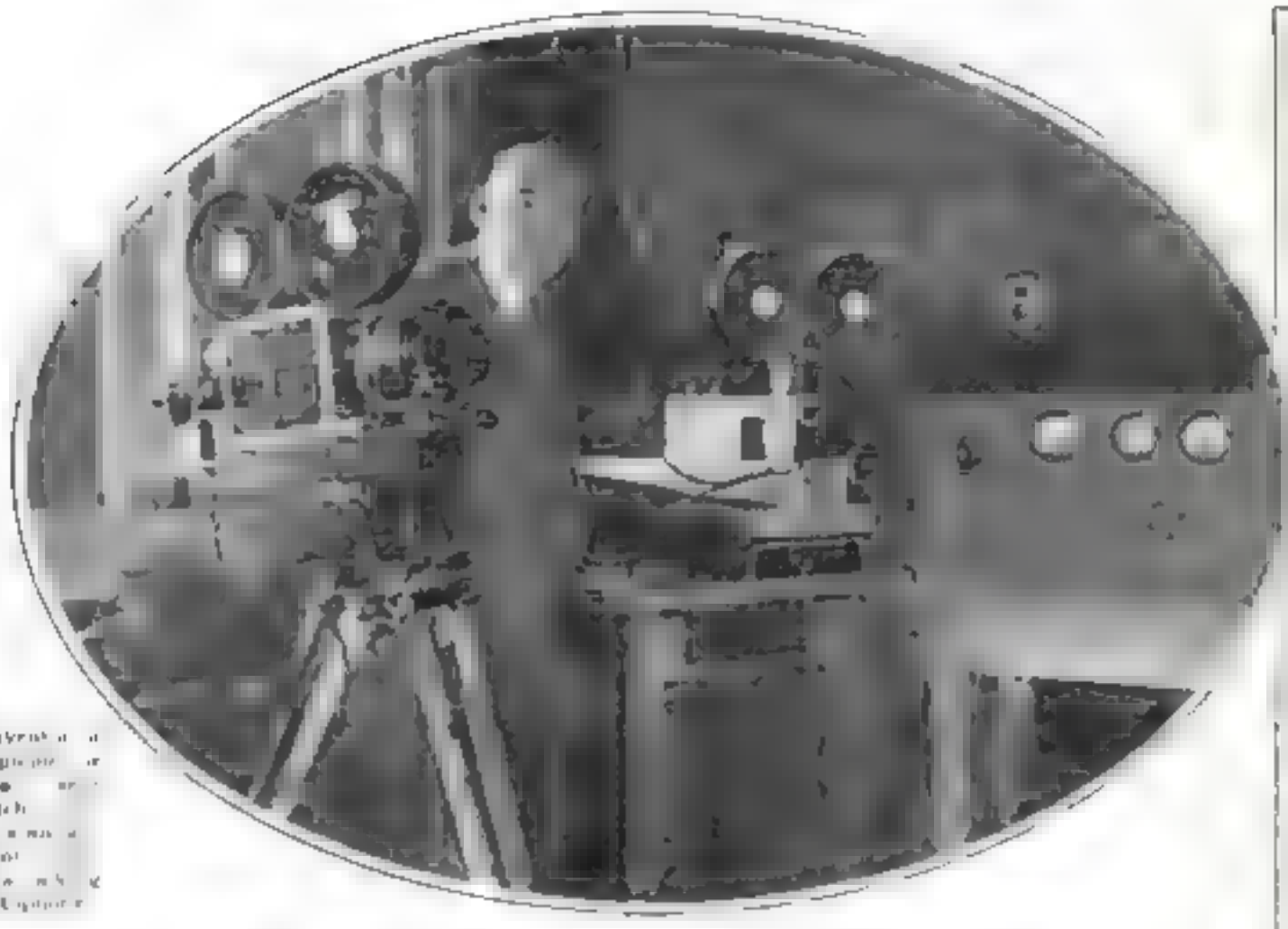
The insulation on the wires inside your radio set is of no importance at the points where the wires are so spaced that they are not likely to touch each other.

A B C's of Radio

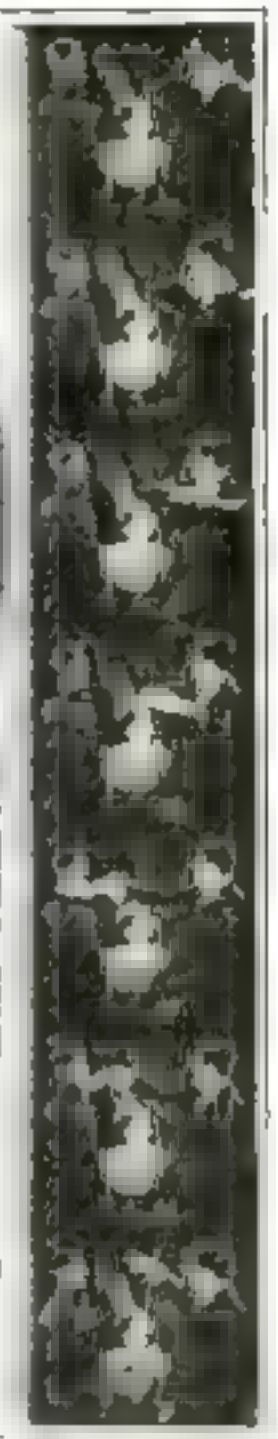
WHILE extreme selectivity is a worth while quality in a radio set because it enables you to choose between stations that are close together on the wave length band, it is not desirable to have this quality carried to extremes. All the broadcasting stations radiate a wave that is of measurable width, and if your set tunes too sharply it is bound to cut off what are known as the side bands, with a consequent loss in tone quality.

Cutting off the side bands through too sharp tuning reduces the strength of the higher audible frequencies, with the result that voices have a tendency to sound throaty and music sounds as if it is coming out of a barrel.

If there is a selectivity control on your radio set, always operate it with the tuning as broad as possible without making it impossible to cut out interference.



C. A. Hoxie [illegible] the pallophotographic [illegible] "sound camera" [illegible] et light which [illegible] bines with [illegible] movie projector [illegible] to form the new [illegible] movie "photophone"



Photophone film showing sound strip along left margin

Talking Movies *Take Step* Ahead

Invention Prints Sounds and Pictures on Same Film, Uses Standard Movie Projector

By ALDEN P. ARMAGNAC

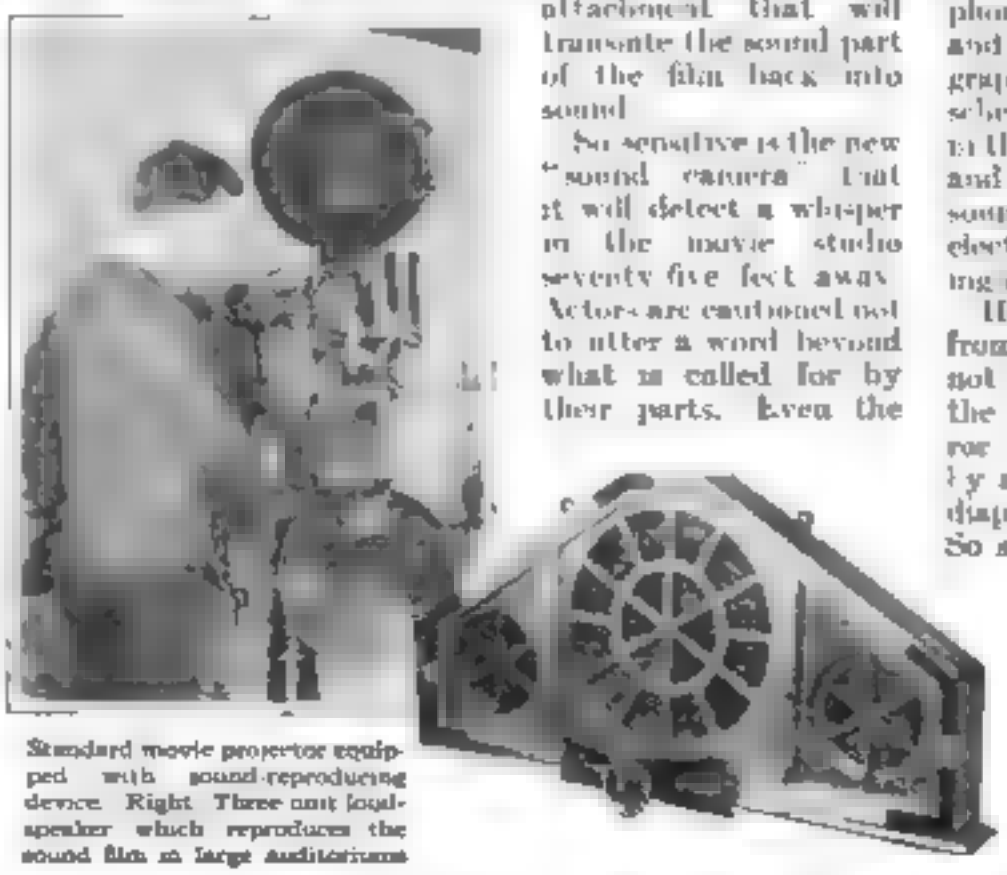
CALLED the "photophone" by its inventor, C. A. Hoxie, a new device to merge motion pictures and sound, developed after several years of experiment at the Schenectady, N. Y., laboratories of the General Electric Company, amazed spectators recently at its first demonstration.

The new device prints the voice and pictures on the same film, thus eliminating the danger that the actor's lips and the sound of his voice may not be timed together. A "photophone" or sound camera, special electric motors, and an ordinary movie camera work together to make these remarkable films.

The standard movie machine, cranked not by hand but by a special electric motor, takes the picture. Meanwhile a microphone in Dr. Hoxie's "sound camera" picks up the actors' voices and incidental sounds. Driven by another motor timed to keep step with the first, the "sound camera" turns the analyzed sound waves into light waves and impresses them on a separate film.

Now experts in the photographic dark room place together the two films, one bearing the pictures and the other the sound record, and print them simultaneously on a single strip to yield the reel that will be sent to a theater. To the projector of the theater is easily fitted a special attachment that will translate the sound part of the film back into sound.

So sensitive is the new "sound camera" that it will detect a whisper in the movie studio seventy-five feet away. Actors are cautioned not to utter a word beyond what is called for by their parts. Even the cooling of the movie camera requires that the sound recorder be placed at some little distance from it. It is this amazing delicacy that has required years of research.



Standard movie projector equipped with sound-reproducing device. Right, Three-unit loud-speaker which reproduces the sound film in large auditoriums

OTHER inventors have traveled different roads to achieve talking movies. Best known perhaps of recent inventions the "vitaphone" uses a phonograph record to record the sound, and synchronizes the reproducing phonograph with the movie projector. Another scheme, like Dr. Hoxie's "sound camera" in that it attempted to photograph sound and pictures on the same film, had the sound microphone cause a lamp in an electric circuit to flicker, to yield a varying light record.

Here is where the photophone differs from these attempts. Its light does not flicker—it has no connection with the microphone. Instead, a delicate mirror joined to the "mike" diaphragm by a thin connecting rod rocks as the diaphragm pulses when sound strikes it. So small and light is this mirror that it would take four of them, with diaphragm and rod added to each, to equal the weight of a pin's head! A narrow shaft of light ricochets from the rocking mirror and traces a zigzag pattern on a film in the sound camera—a pattern that corresponds exactly to the sound which is being recorded.

Our Growing Debt *to* Science

How Lightning and Earthquakes Travel—New Paper Textile Developed The Perfect Mutton Sheep Other Advances

On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.

Animal Breeding Cuts Living Costs

THE world's supplies of vital necessities from the farm, such as meat, milk, wool and grain, depend more and more on remarkable experiments in breeding better animals and better crops.

Recently, for example, experts of the animal breeding research department of Edinburgh University completed experiments which promise farmers the ideal mutton sheep—one which will produce an abundance of finest wool, and also will bear twins with surprising regularity. The same scientists are at work to increase the milk yield of goats and cows.

Unsuspected economies in feeding live stock are revealed by other experiments in the Nutrition Laboratory maintained in Boston by the Carnegie Institution of Washington. It was found, for instance, that grown steers apparently can live through the winter on extraordinarily low rations without harmful effects.

In Switzerland two veterinarians, Dr. Gruber Ferdinand and Prof. W[illegible] ber of Zurich University, report success in rejuvenating aged cows and goats by gland operations.

Research such as these will have important bearing on the prices we pay for food and clothing.

Amateurs Discover Comets

REMARKABLY enough, the two most recent discoveries of comets in the heavens have been made, not by professors with high power telescopes, but by amateur astronomers who gaze into the night skies as a hobby. A new comet of the eighth magnitude, too faint to be seen without a telescope, was found a few weeks ago by William Reid of Rondebosch, South Africa. Several days previously the year's first comet had been discovered by another South African amateur by the name of Blathwayt.

Fireflies' Secret Sought

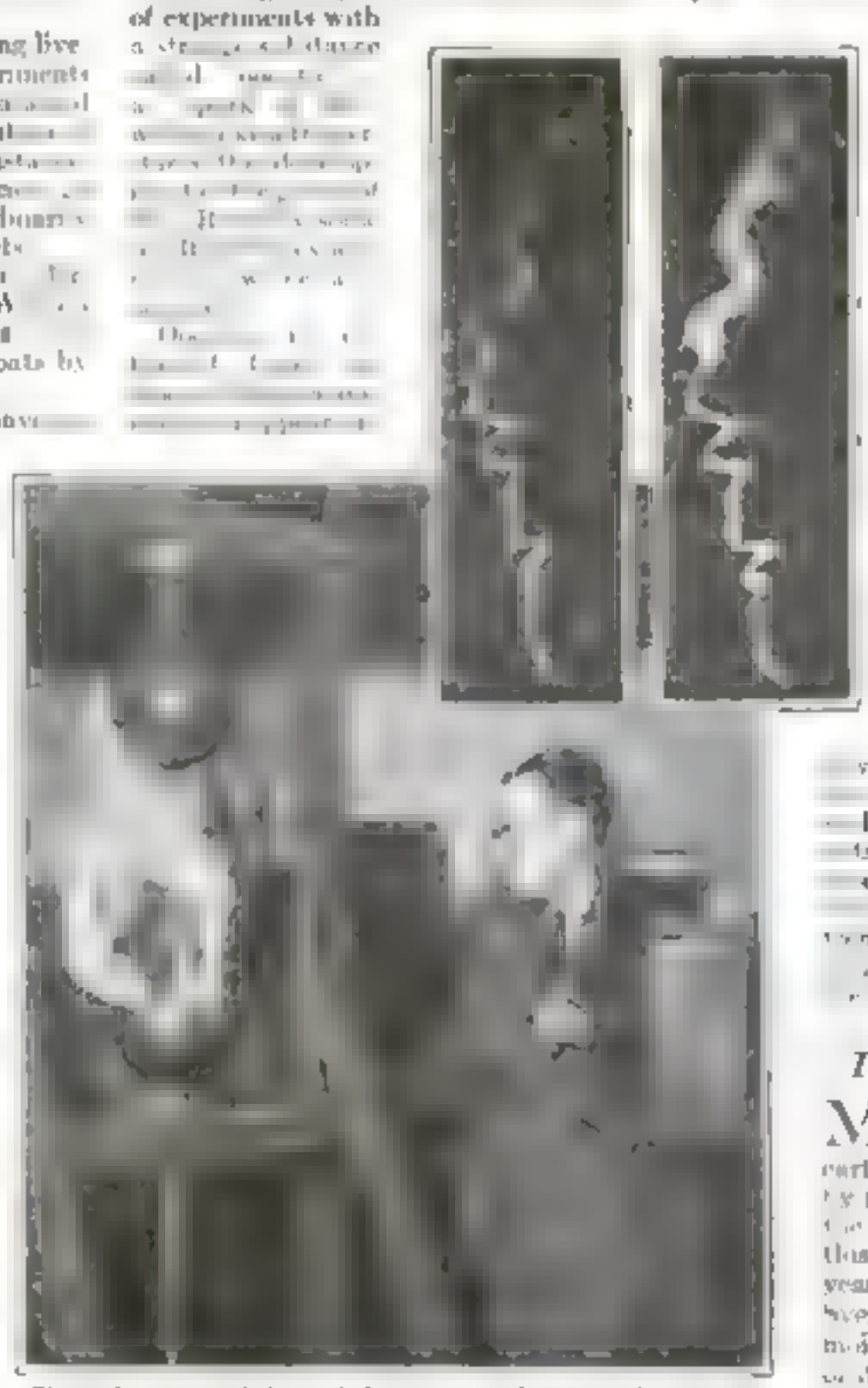
IF SOME inventor could duplicate the processes by which fireflies produce their "cold light," he would doubtless revolutionize artificial illumination. For the efficiency of these creatures in getting light out of a given amount of energy puts our most improved incandescent lamps to shame.

Two Government scientists, Dr. W. W. Coblentz and Dr. C. W. Hughes of the Bureau of Standards, analyzing this cold light, have split it into its various colors and measured the energy in each color. They have found, for one thing, that in different glowing organisms there is a wide variation in the colors that compose their light.

Other studies by Prof. E. N. Harvey of Princeton University indicate that the light is produced not by combustion but by a kind of digestive process.

Animal Life Chemically Started

FOR twenty years biochemists of the University of California have worked to wrest from Nature some of the secrets of life's beginnings, in a remarkable series of experiments with a [illegible]



That lightning travels in a spiral, not in jagged leaps, is the discovery of J. W. Legg, New York engineer, as a result of experiments with his new high-speed camera. He is seen photographing a 200,000-volt arc. Above, a flash as seen by the eye (right) and by the new camera

a grayish white powder. The most significant experiment, apparently, was the actual fertilization, with it, of eggs of the common sea urchin. In other words, new individuals were actually produced by the substance, though its chemical composition still baffles.

Rich Children Steal, Poor Honest?

BY PRYING into the workings of our minds and emotions, psychologists are supplying startling new knowledge on such varied subjects as how to choose a vocation, how to pick a wife, and how to bring up children.

In Paris, laboratory tests are being applied in real life to help young people pick the trade or calling for which they are best fitted. The work is under the guidance of Henri Pieron, head of the Sorbonne laboratory of physiological psychology.

That too much wealth tends to make people dishonest was believed to be indicated by recent tests at Columbia University. Hundreds of children of varying circumstances were given little boxes containing coins and told to solve a puzzle involving use of the coins. Of 250 orphanage children, only six stole from the box, while eighteen out of a hundred pupils from an expensive private school succumbed to the temptation. And investigators at Stanford University, California, are studying [illegible] differences between men and women in character, talents and abilities. They hope, among other results, to answer the question whether the extremely masculine man and the "clinging vine" woman make the ideal marriage!

Trailing Ancient Man

MUCH of all we know about the history of the earth has been brought to us by men who risk their lives in the search for knowledge. As this is written, a sixty-one-year-old Swedish explorer, Dr. Sven Hedin, braves the turmoil in China and the hostility of its people to explore deserts of inner Asia, now barren, but believed once to have been a melting pot of peoples.

Other explorers, who are digging into ancient soils, recently have come upon fascinating relics. A little headless statuette of a woman—a "Stone Age Venus"—probably 25,000 years old, has been found near Vienna. Paintings excavated at Corinth give evidence that ancient Greek athletes excelled our modern champions in agility. In Egypt has been found the secret tomb, filled with treasures, of Queen Hetepheres, who lived 3,000 years ago and is believed to have been the mother of Cheops, the pyramid builder, most famous of all the Pharaohs.

From the soil of every land science is unlocking a wealth of new knowledge.

He Makes Earthquakes to Order

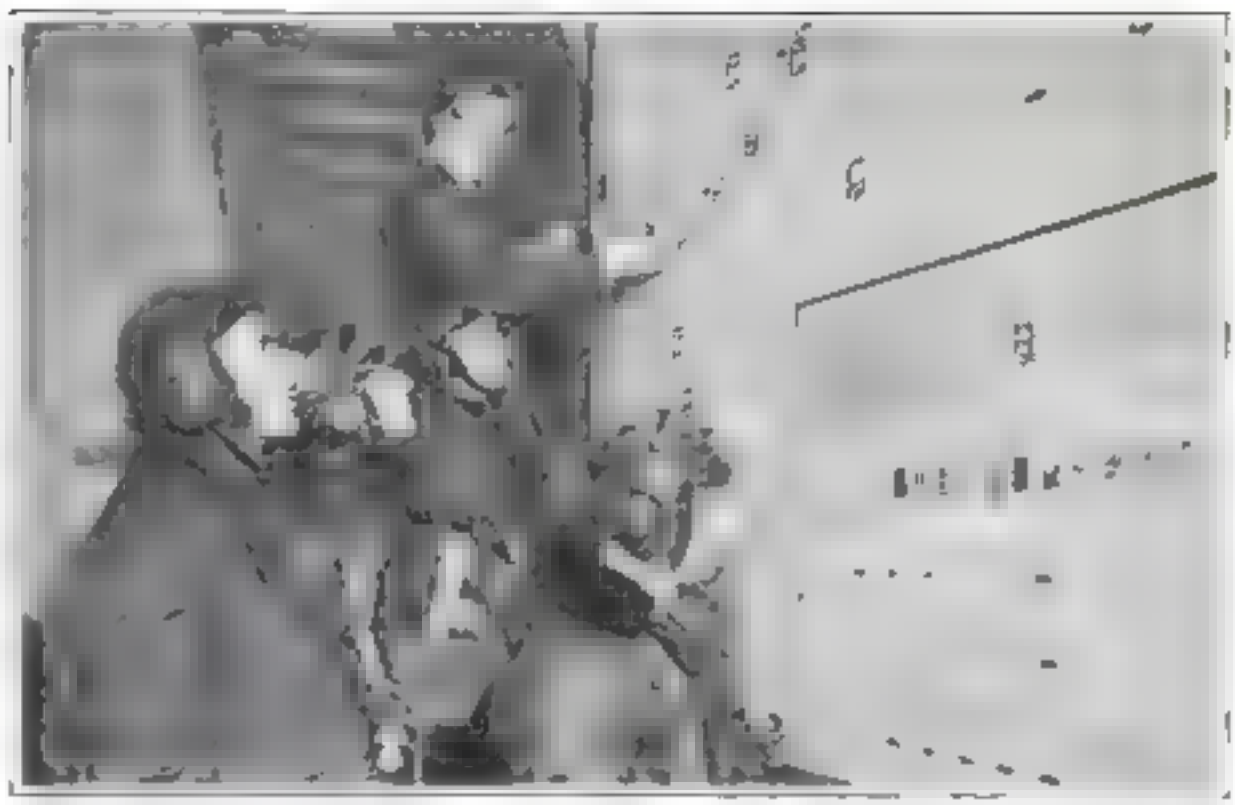
ATTEMPTING to find new facts about earthquakes, C. Mauram, a French scientist, grew impatient with waiting for natural earth tremors and accordingly devised a way to make earthquakes to order. His made-to-order quakes were achieved by shaking the granite strata about the town of La Courine with carefully timed and measured explosions. The effect of the blasts at recording points was recorded with seismographs. His results, for that locality, showed a speed of about three and a half miles a second for the first shock.

Woman Invents Paper Textile

VISITING a Paris dressmaker several years ago, an American woman remarked half jokingly, that it was a pity paper could not be used instead of wool as an interlining for coats. Today, after years of study the woman who made that remark

Mrs. Nina Parven, of Stockbridge, Mass.—has developed a remarkable new textile material of paper composition which promises to find countless uses in the making of clothes.

According to descriptions given, the new textile, called "sona," has neither warp nor woof, nor any considerable bulk or weight. It is said to wash and iron like cloth, remain unaffected by steam or heat, and yet is tougher than leather and impervious to wind, cold, dust or moths. Having no threads, it cannot ravel.



New shorthand weather signals tell cross-channel British aviators at a glance the weather they will encounter en route. Demonstrated recently at the Croydon airdrome in England, they combine in one rectangle strips to indicate the weather, dangerous low clouds and the visible distance

Lightning bolts that might set oil fields blazing may be tamed by two Los Angeles scientists, who have hurled miniature thunderbolts from a wire screen overhead at a model petroleum-filled tank without igniting the oil. In the illustration John M. Cage, the inventor, is pointing out grounded "protection wires" encircling the tank, that conduct the electricity harmlessly away

Mind Reading Tested by Radio

IS THERE such a thing as thought transmission? A few weeks ago, tentatively, we pointed to two new scientific tests, one the most spectacular perhaps, in its history.

Dr G H Estabrooks of Harvard University conducted one test. A person sitting at a table turned over a pack of playing cards one by one, focusing his mind always on the card turned up. At an electric signal a person in another room endeavored to tell which card was being thought of. The results, according to Dr Estabrooks, showed a higher percentage of correct guessing than could be explained by any theory of chance.

Far more spectacular was the nation-wide radio telepathy test staged in England by Sir Oliver Lodge in conjunction with the Society of Psychical Research. Various objects, such as playing cards, were shown to six "agents," and while they concentrated on the object, Sir Oliver, broadcasting by radio, asked the listeners-in to tell what the object was. More than 10,000 replies were received the results of which, at this writing, have not yet been tabulated.

Minnesota Makes Radio Record

NORWEGIAN anthropologists, aboard a whaling vessel 600 miles from the South Pole a few weeks ago, picked up a radio message sent from Minneapolis, 11,000 miles away. The signals, dispatched from the University of Minnesota, established a new long distance record for short wave transmission, coming within a thousand miles of going halfway around the globe. A wave length of thirty-eight meters was used for the transmission.

Puzzling Angles Spring to Life

The Handspring
Third Prize
Virginia Buttry,
Rogers, Ark.

Winners in Our Stomachion Contest

IN OUR February issue we offered $100 in cash prizes to readers submitting the best original designs of human figures made from the fourteen pieces of the Stomachion puzzle game of Archimedes. A number of the prize winning entries are reproduced here. The prizes have been awarded as follows

FIRST PRIZE, $25—Mrs. George A. Reilly, Providence, R. I.

SECOND PRIZE, $15—Rev. F. C. Rufle, Newton, Kansas

THIRD PRIZE, $10—Virginia Buttry, Rogers, Ark.

Five Prizes, $5 each

R. P. Frutchey, Paterson, N. J.
Lt. W. W. Jervey, West Point, N. Y.
Paul Leuchel, Hagerstown, Md.
Kathryn L. Smith, San Francisco, Calif.
A. E. Warren, Ada, Ohio.

Ten Prizes, $2.50 each

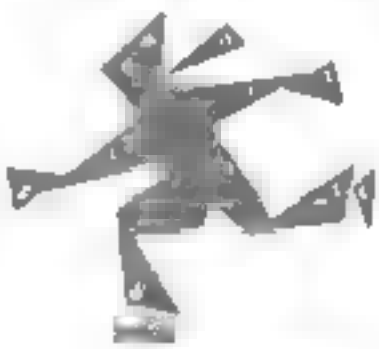
Mrs. L. A. Nelson, Abingdon, Ill.
William H. Schneider, Brooklyn, N. Y.
Lucile S. Lovett, Weaverville, Calif.
A. M. Wagner, Leonia, N. J.
Sue D. Runyon, Wilmington, N. J.
Esther Teseno, Mason City, Iowa
Evelyn M. Harris, Nassona, Minn.
Paul R. Benfare, Morristown, N. J.
J. Fel Fraser, Vancouver, B. C., Canada
Mrs. W. N. Olive, New Iberia, La.

The Hold-Up
A. E. Warren,
Ada, Ohio

The Ski Jumper
Lt. W. W. Jervey
West Point, N. Y.

The Cheer Leader
Paul Leuchel
Hagerstown, Md.

Old Lady with Umbrella
First Prize
Mrs. George A. Reilly
Providence, R. I.



The Skater
R. P. Frutchey,
Paterson, N. J.

The Goose-Step
Second Prize
Rev. F. C. Rufle,
Newton, Kan.

Wild Mongols Torture American Scientists

TWO men who dared torture at the hands of savage Mongolians to obtain scientific trophies in strange forbidden lands—William J. Morden, leader of the expedition and James L. Clark, assistant director of the American Museum of Natural History returned the other day from their perilous search. Scarred bodies testified to their grisly experiences.

From the icy fastnesses of the Russian Pamirs they brought the finest collection ever made of the rare *ovis poli*, the fabled mountain sheep of Marco Polo, and the first motion pictures of it ever taken. In the dizzy heights of the Thian-Shan mountains of China they caught roe deer and specimens of the great Thian-Shan ibex. They traveled, in their quest, from 500 feet below sea level in the great salt waste of Turfan to an altitude of 16,500 feet in the Pamirs. Captured by armed Mongols, they were beaten and held prisoners by cords about their wrists, drawn as tight as two men could pull them and shrunk still tighter with boiling water. Finally released by Russian intervention, they made their tedious way to the Trans-Siberian railroad, whence they returned Peking and home.

Specimens they obtained and photographs that are unique—including even pictures of the savage Mongols who tortured them—will soon occupy a place of honor in the museum. Their wrists are now practically healed, though they still occasionally feel a sort of electric shock where the nerves were smashed.

Mr. Clark gives a vivid picture of their trip over the Bursil Pass, between great peaks 16,000 feet high and through blinding whirlwinds of snow. "We had to travel early in the morning, for the heat of the sun was so terrific that at its height it melted the snow so that anything would start an avalanche. A footfall, even a shout, would bring down a snowslide."

Courtesy The Nat. Hist. Mag.

J. L. Clark on a yak hunting the *ovis poli* in its bleak Asiatic haunts

Are We Electric Batteries?

Tiny Life Cell, 4/1000th Inch Long, Electrified in Amazing Experiment, Becomes More Active Than Ever

By H. H. Dunn

WITH a glass tube whose point is smaller than a single life cell, a microscope and a supply of electricity, a scientist in the zoölogy department of the University of California has just demonstrated that protoplasm the substance of which all living organisms are made, is an excellent conductor of electricity.

More, he has shown that electricity not only fails to injure the life cell, but leaves it stimulated, more active than ever.

Dr. Jacques Loeb, world-famous biochemist, held that life is a chemical mechanism. Dr Albert Schweitzer, bacteriologist and fellow of the American Association for the Advancement of Science, announced this winter his belief that the body of man is comparable to a storage battery that vitality may be restored and years of activity prolonged, by the application of certain chemicals and the electric current to the body.

Now comes Dr Samuel Gelfan, of the University of California, with the discovery, announced through Dr. C. A. Kofoid, chairman of the zoölogy department, that protoplasm is an excellent conductor of electricity; that the basic substance of which the human body is made is stimulated by the electric current, but not destroyed by it.

Dr Gelfan, who has projected an electric current through a single life cell, demonstrating his method to a student. Below, the microelectrode he devised for the experiment drawn by himself; its actual size is less than half that of the drawing.

IN HIS remarkable experiments, Dr. Gelfan dealt with a single cell approximately four thousandths of an inch in diameter. To introduce the electric current to this minute organism he had to devise an electrode less than one thousandth of an inch across its tip!—smaller even than the microscopic cell.

How he accomplished this, solving a problem on which scientists have been working for a quarter of a century, Dr Gelfan tells:

"To force an electric current through the microscopic 'spark of life,' I had to devise electrodes with ends sufficiently small to penetrate the cell without destroying it. I took a quartz tube about nineteen thousandths of an inch in diameter, heated it over an oxygen microflame, and, at the proper instant, pulled it apart rapidly. In the first pulling apart, I ruined hundreds of tubes by having too great or too little heat, by the unsteady movement of my hands, collapse of the minute tube, or for various other reasons.

"Taking one of these already almost microscopic tubes, I drew it out again in the oxygen microflame until it was less than one thousandth of an inch in diameter, with a cone in the end one two thousandth of a millimeter wide. I made two of these, filled each with agar, after cutting the fine ends off evenly under the microscope. The agar, I found, was the best conductor for the electrode because of its salt content.

"Silver wire, coated with silver chloride, was inserted in the large end of each of these pipettes, and I found myself with two nonpolarizable microelectrodes. It took me more than a month to complete these fairy-thread electrodes, so many were the tubes broken, closed by heat or otherwise rendered useless."

Then Dr. Gelfan cornered his protoplasm, the Adam and Eve of the biologist, the beginning of life. With it beneath the eye of a powerful microscope, the microelectrodes were fixed in carriers which could be advanced one ten thousandth of an inch at a time, and minute electric current was applied to them. With such gradation of movement as only the microbe-monger knows, these electrodes were pressed through the "skin" of the single cell. A delicate galvanometer showed the current to be passing through the protoplasm. Thus was established the conductivity of the life cell.

"The protoplasm was then released, in the infinitesimal drop of water from which it was taken," says Dr Gelfan, "and it at once showed greater activity than ever." The experiment was conducted repeatedly, with other protoplasm, with the same results.

DR. GELFAN'S discovery seems to be the first step into a new field. There is talk of the worn out machinery of our human bodies. Immunity to disease has advanced tremendously in the last quarter of a century. Where, so late as 1914, the life expectation of a child of ten years was fifty-nine years, it is sixty-four years for a child of the same age today. "It is disgraceful or criminal now to die under seventy-five years of age," says Dr. E. S. Gilmore president of the American Hospital Association.

Yet all this lengthening of life has been accomplished without the discovery of any method for actually restoring, or replenishing worn-out tissues of the body. Loeb and Northrup have held that "natural death" is due to the breaking down of the body cells. Dr. Alexis Carrel has made bone grow new bone, muscle tissue produce new tissue, apart from the animal body from which bone and muscle came. The discovery of bacteriophage—those infinitesimal entities which destroy microbes—provides us with an agency for the control and prevention of epidemic diseases. But science still has not discovered the means whereby new tissue may be replenished at the rate it is "burned up."

What we now need is a means of restoration and stimulation, not of the glands and organs of the body, but of the microscopic, individual cells of which the body is composed. Dr. Gelfan's discovery seems to be a step in that direction.

Mice Army Invades California County

HASTILY organized squads of men in Kern County, Calif., are resorting to warlike methods to check an unprecedented migration of house mice. Ousted by torrential rains from a dry lake bed, millions of the rodents have overwhelmed neighboring towns. At Taft, a 600-foot trench three feet deep, strewn with poisoned wheat, was soon filled with their dead bodies. In Maricopa and Bakersfield fire-circled areas and poison gas were the weapons used. In many places highways are covered with dead mice that they are trying to reach for water at night living ones come to eat the

Victims in California and their foe

Jupiter Swings In

FREAK weather and possible earthquakes are predicted by some scientists as Jupiter approaches the sun, to reach his nearest this year and the following twelve months. Our neighbor planet, they say, has a far-reaching influence on our solar system by virtue of his enormous size—illustrated in the imaginary drawing at the right. Suppose Jupiter were put in the place now occupied by the moon. What a magnificent sight he would be as he rose from the sea! His glowing disk, streaked with pinkish belts, would show the mysterious and historic Great Red Spot that first puzzled astronomers in 1857. The moon appears an insignificant dot at the upper left. When Jupiter reaches his nearest approach to the sun this year—and it may be significant that the period of maximum sun spots is expected to occur at this time—the Earth, during the autumn, will pass between the two greatest members of the solar system. Abnormal weather and increased seismic strain resulting possibly in earthquakes, are forecast.

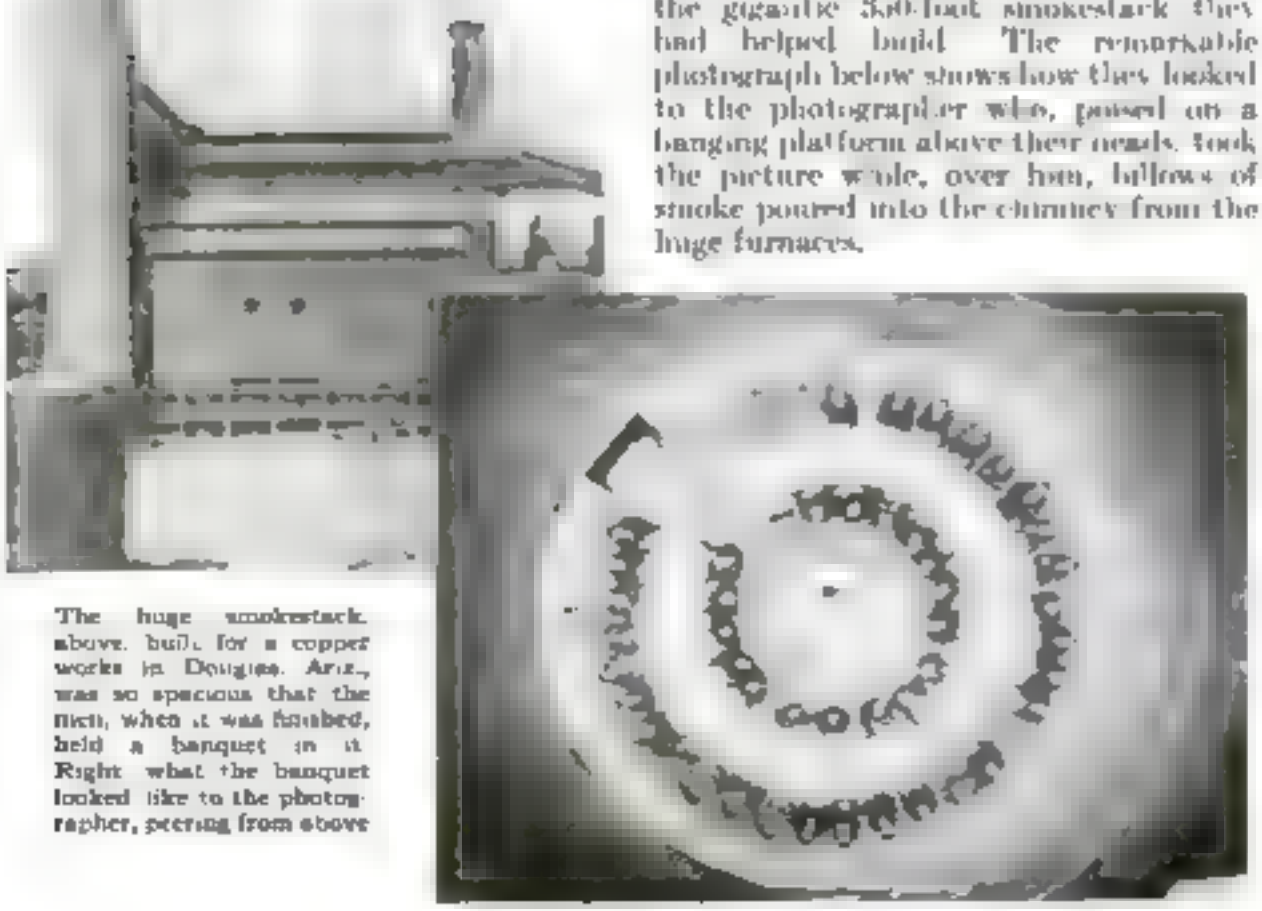
If Jupiter were as near to us as the moon is now

New Record for Seaplanes

AN UNOFFICIAL world's record for a seaplane was made recently by Lieut. Frank H. Conant, flying in a Navy racing seaplane over a six-kilometer (four mile) course over Long Island Sound at 250 miles an hour. The previous record for seaplanes was 247 miles an hour. A French airman holds the record for airplanes, 278 miles an hour.

A Banquet in a Smokestack

WHEN fifty men who had built the new refinery plant of a great copper works in Douglas, Ariz., gathered recently to celebrate the completion of their task, their unique banquet hall was the base of the gigantic 300-foot smokestack they had helped build. The remarkable photograph below shows how they looked to the photographer who, poised on a hanging platform above their heads, took the picture while, over him, billows of smoke poured into the chimney from the huge furnaces.



The huge smokestack, above, built for a copper works in Douglas, Ariz., was so spacious that the men, when it was finished, held a banquet in it. Right, what the banquet looked like to the photographer, peering from above

Way Found to Film Bacteria

DEADLY bacteria can seek their victims as actors in amazing [illegible] revealed by Dr. H. J. [illegible] of Columbia College of Physicians. [illegible] developed expressly for this form of microphotography, made possible his remarkable pictures.

Motion pictures of bacteria have hitherto been impossible because the intense heat of the ordinary moving picture light source instantly killed all germs in its path. In taking the new pictures, a current of ice water was arranged to flow beneath the glass slide bearing the living bacteria to filter out the heat from the powerful light at the base of the instrument. In this way the movements of living bacteria and other tiny cell structures are photographed and studied.

Diamonds in America

SEARCH for diamonds in the United States has revealed unsuspected riches in widely scattered districts. In California along the Piedmont section of the Atlantic Coast and in the Great Lake region the gems have been found.

Arkansas has the only diamond mine in North America, however. At Murfreesboro, in Pike County, is a mine said to have yielded more than ten thousand gems since it was discovered in 1906. Finest of all was a diamond found there in 1924, largest ever found on this continent. It weighed 40.23 carats.

Flies Taste with Their Feet?

THAT a fly tastes with its feet and not with its proboscis, is the theory of Dr. Dwight E. Minnich of the University of Minnesota, following interesting experiments. Placed on a tasteless oil, the flies seldom took the trouble to extend their proboscides, or suckers, seeming to know in advance that it was worthless as food. Allowed to walk over wet sugar, however, an instantly an army of hungry "suckers" descended to lap up the food.

AMERICAN WOMEN have lost 3500 tons of hair to the barbers' shears in adopting the bobbed hair fashion, estimates a permanent wave specialist. There are 14,000,000 with bobbed heads in this country and half of them spend $15,000,000 a year for having their locks waved.

Factory Power *from* Tropic Seas!

Frenchman Plans Strange Floating Islands to Harness Ocean's Heat

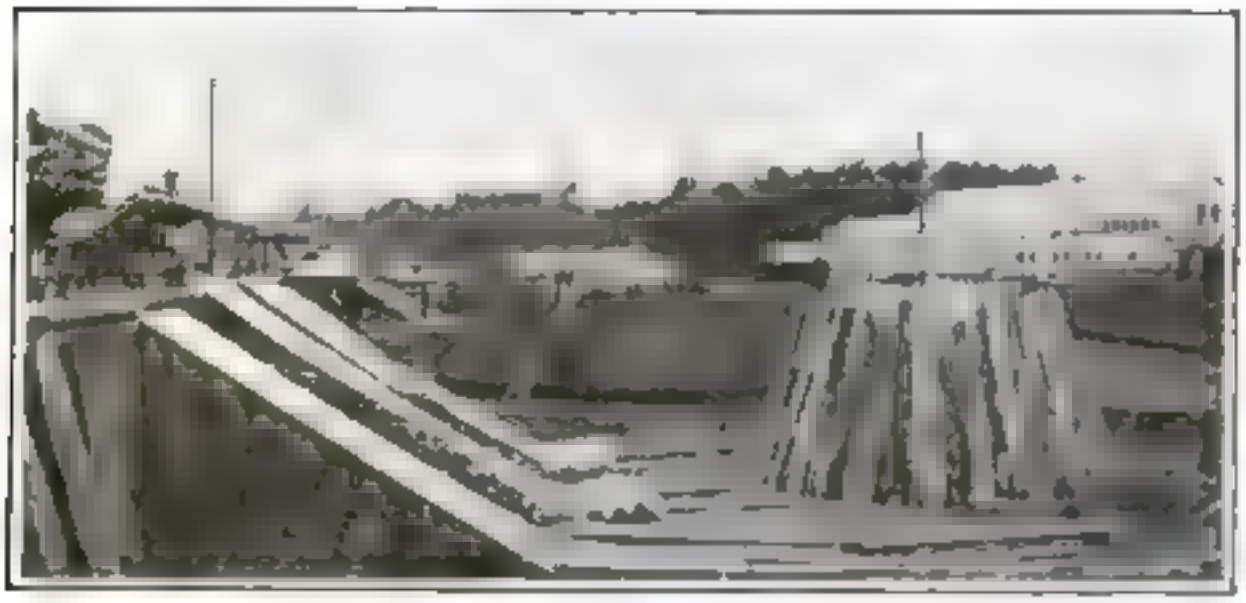
THAT floating factories drawing their power from the ocean depths may some day dot the tropical seas is the amazing prediction of Prof. Georges Claude, French inventor, in suggesting a method of harnessing the vast stores of "thermal energy" of warm seas.

What such factory islands would be like is graphically shown by our artist above. Factory and power buildings would be side by side. At the edge of the island, which, Claude suggests, may be a quarter of a mile in diameter, ships would draw up to discharge supplies and take on cargoes. Anchors attached along the rim by hydropneumatic shock absorbers would keep the pontoon-supported, hexagonal island from drifting.

With his co-worker, Paul Boucherot, Prof. Claude has exhibited before the French Academy of Sciences a working model to prove correct his contention that, in a partial vacuum, tepid water will boil of its own accord to furnish steam. The same idea is applied to his island factory. For each power-house section, a pipe draws tepid water into an evaporating chamber, where under reduced pressure it would flash into steam. Led into the immense slow-speed turbines, the steam drives their whirling blades and is condensed by cold water, piped from a depth of three thousand feet in a huge central conduit.

Such a plant might develop three hundred thousand horsepower, Claude says.

Wood Waste Helps Make Fine Swedish Iron



WHEN a forest log is sawed into planks, there is bound to be some waste, the circular, bark-covered outside will not make trim boards. Instead of throwing it away however, Swedish mill owners have found a new use for it in the country's blast furnaces. Made into charcoal, it extracts pure iron from the red ore. Huge piles of leftovers from the whirring saws are saved from the waste heap by this efficient scheme.

By river, from the woods where the trees are felled, come other odd logs, part of the usual waste of lumbering. They, too, are made into charcoal. In the illustration above a trainway is seen at the left bringing this timber to join the sawmill by-product at the stacking yards.

Dinosaur Tracks in Connecticut

WHERE a power dam now rises, in North Branford, Conn., a dinosaur once strode with mighty tread. This was the unexpected discovery of Dr. Malcolm R. Thorpe, curator of the Peabody Museum at New Haven, during the building of the dam, when the unmistakable three-toed footprints of the prehistoric monster were found clearly marked upon the red sandstone rock shale.

Dinosaur traces have been found before in the Connecticut River Valley, but never before as far south. Their three-toed tracks are six inches long.

No Poison in Carbon Paper

SUSPECTED of having caused the death of one man and the serious illness of another by septic poisoning, the carbon paper used everywhere to make typewritten duplicates has just been given a clean bill of health by the U. S. Bureau of Standards.

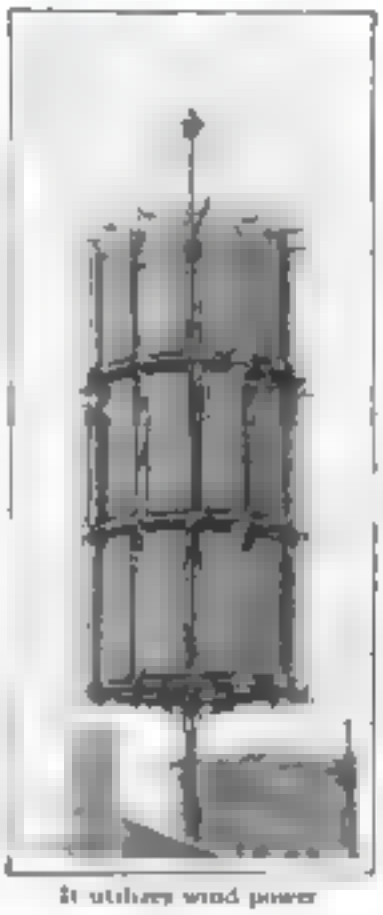
Septic poisoning results from bacterial infection that follows skin irritation by injurious chemical substances. When a War Department employee died recently samples of the carbon paper he had been using were submitted to the Bureau for test with the results stated above. No traces of soluble acid, alkali, or compounds containing free cyanide were found.

London Statue Aged by Coffee

NEW statues speedily become old ones in London, England. When a recently erected statue of Joseph Chamberlain in the House of Commons lobby was found too glaringly new to harmonize with its dignified surroundings, the art work was given a coffee bath that effectively subdued its self-assertiveness. A previous washing of the statue with tea had failed sufficiently to steep the newcomer in tradition.

Glass Bell Hothouses

NEAR the Croydon airdrome, in England, is one of the strangest gardens in the world. Row upon row of bells line the open field! The bells, or "cloches," are of glass, and protect early vegetables from the late winter frosts. Beneath them early vegetables mature ahead of time for the London market. When the vegetables are ready to be picked the bells are lifted aside. The scheme comes from France, and is now being tried out on a large scale at the London suburb.



It utilizes wind power

New Picture-Telegram Service between Berlin and Vienna

FASTER even than word-for-word transmission, the newest method of sending radiograms transmits a picture of the actual message. Perfected at Berlin, it radios written matter covering the space of an ordinary post card in three seconds. In the service to be opened between Berlin and Vienna based on the new system, this time will be lengthened slightly to insure accuracy.

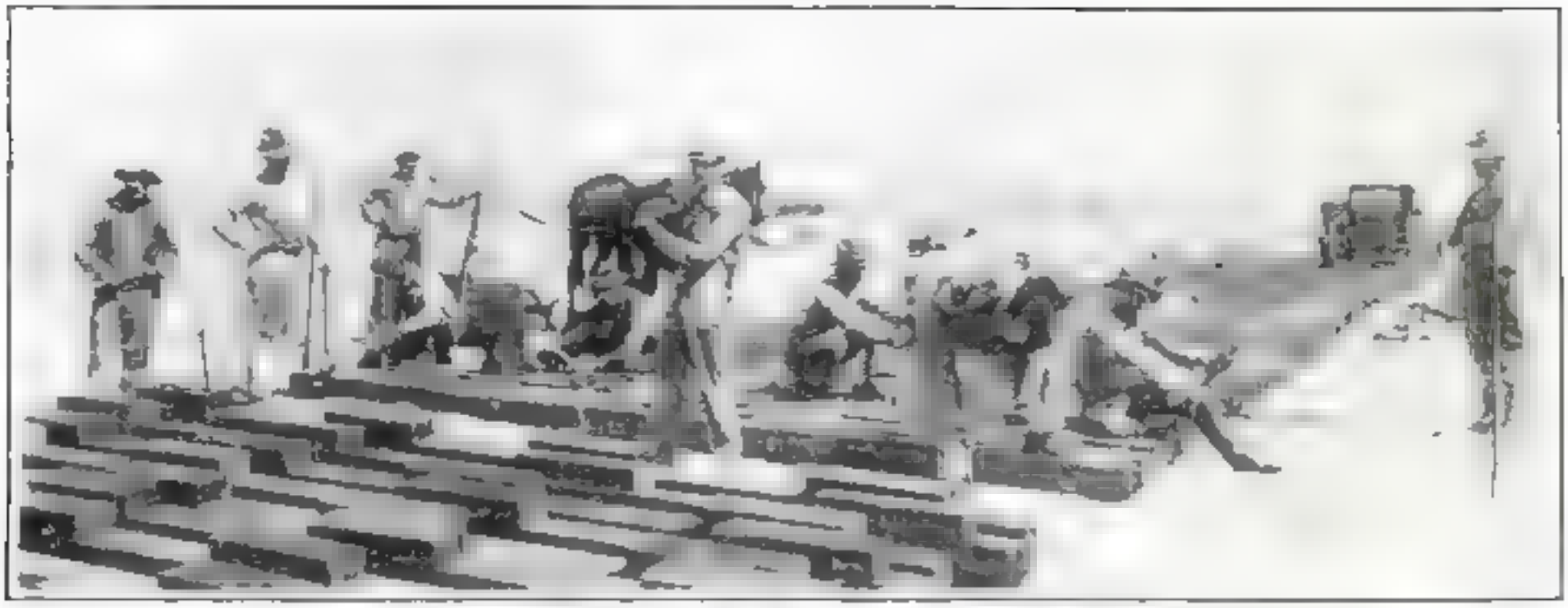
Time is saved in the transmission by an arrangement that makes it unnecessary as heretofore, first to photograph the message. Directly attached to a cylindrical transmitter, the original of the telegram is sent by radio picture. Shorthand symbols or fine print may yield even greater speed, as the smaller the telegram the faster it can be sent.

Builds Rotor Windmill

THE rotor principle successfully developed by Anton Flettner in his famous rotor ships is being adopted in many other useful ways, among them a new wind motor built in San Francisco by John Fletcher-Ford to generate power for moving machinery and for irrigation purposes. The illustration at the left shows its construction.

As in the rotor ship, a small motor turns the cylinder and the revolving surface exerts pressure which is translated into power. This new principle would allow a small motor, aided by the wind power utilized in the cylinder, to do work which would ordinarily require an engine of much greater horsepower.

Part of the French "cloche" garden at Croydon, England. Early vegetables are here successfully forced under glass "cloches," or bells, and are sent up to the London market



California "Picks and Carries" Its Desert Roads after Sandstorms

ORDINARY road building methods would be of little avail on the desert region of California's Imperial Valley, where paths are obliterated overnight by avalanches of wind-blown sand. The California Highway Commission solves the problem by building portable roads, which may be taken up bodily and removed to new locations after windstorms. The road consists of a plank surface laid loosely on cross timbers, as shown in the illustration above.

The timbers are jointed to provide a hinge effect, which enables the road to adjust itself to the surface of the sand.

Your Footprints Betray You

FOOTPRINTS are better than fingerprints or any other scientific method of identification, Dr Joseph J. Interland, New York scientist, believes. Every foot, he declares, shows unmistakable individuality. A study of a thousand pairs of feet has convinced him that the differences are even more striking and various than the finger's loops and whorls.

He is now engaged in demonstrating his method of 'foot printing' for identification to police officials and physicians.

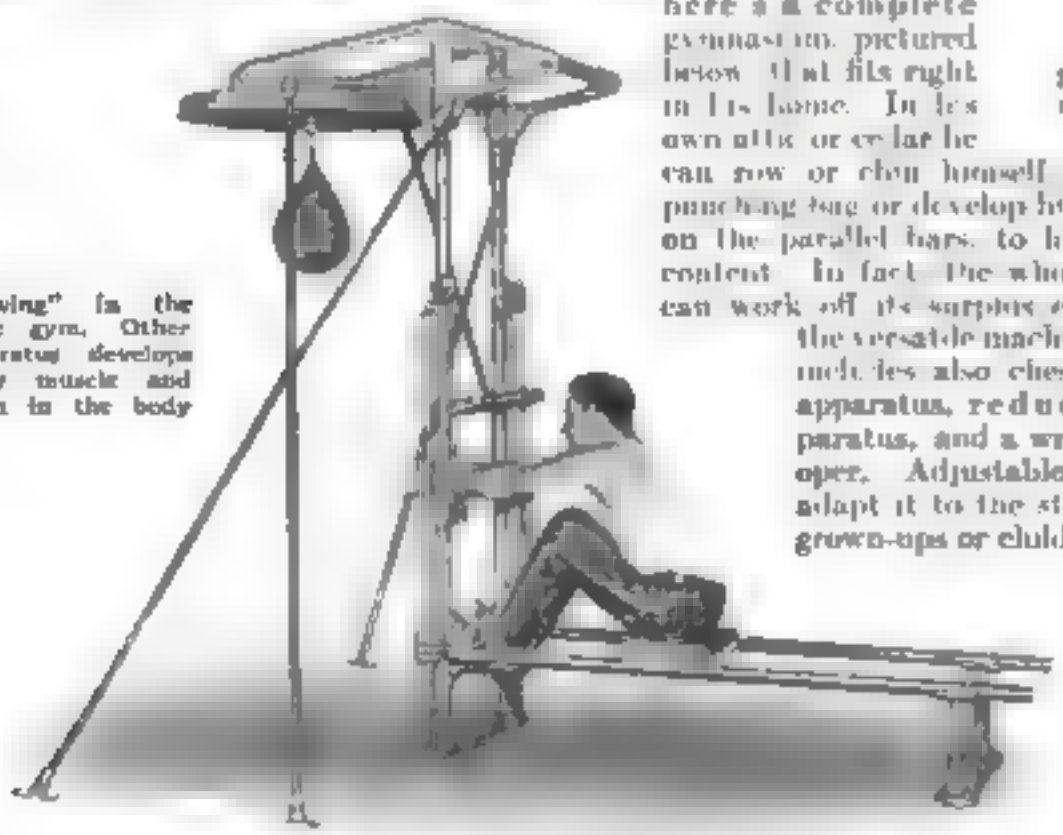
Who Works for a Living?

EVERY third person in the United States goes out and works for a living. The rest are women, children, other dependents, and a very small number of the 'idle rich' and mighty few of the last, for the bulk of the nation's money. Three fourths of it is earned by those who toil. These figures are the latest estimate of the National Industrial Conference Board, which bases them on statistics that have just been compiled.

Among the very rich, many are active in business, nearly half of the class with an income of half a million or more work to earn it. In the highest paid groups, most investments are in stocks. Investments in real estate, bonds and savings accounts are favored by men whose income is five thousand dollars or less.

A Home Gym

FOR the man who likes to top off—or begin the day's work with a little healthy exercise, here's a complete gymnasium, pictured below, that fits right in his home. In his own attic or cellar he can row or chin himself, buffet a punching bag or develop his muscles on the parallel bars, to his heart's content. In fact, the whole family can work off its surplus energy on the versatile machine which molds also chest weight apparatus, reducing apparatus, and a wrist developer. Adjustable weights adapt it to the strength of grown-ups or children.



"Rowing" in the home gym. Other apparatus develops every muscle and organ in the body

Prickly steel points hold the patch firmly in place

This Tire Patch Sticks!

STUDDED with steel points like phonograph needles, a new tire patch sticks where you put it, after running a short distance you won't find it in one place and the hole in another. Simply insert it over the blowout, replace tube and rim, and inflate the tire as usual. Air pressure squeezes the prickly patch into the outer casing.

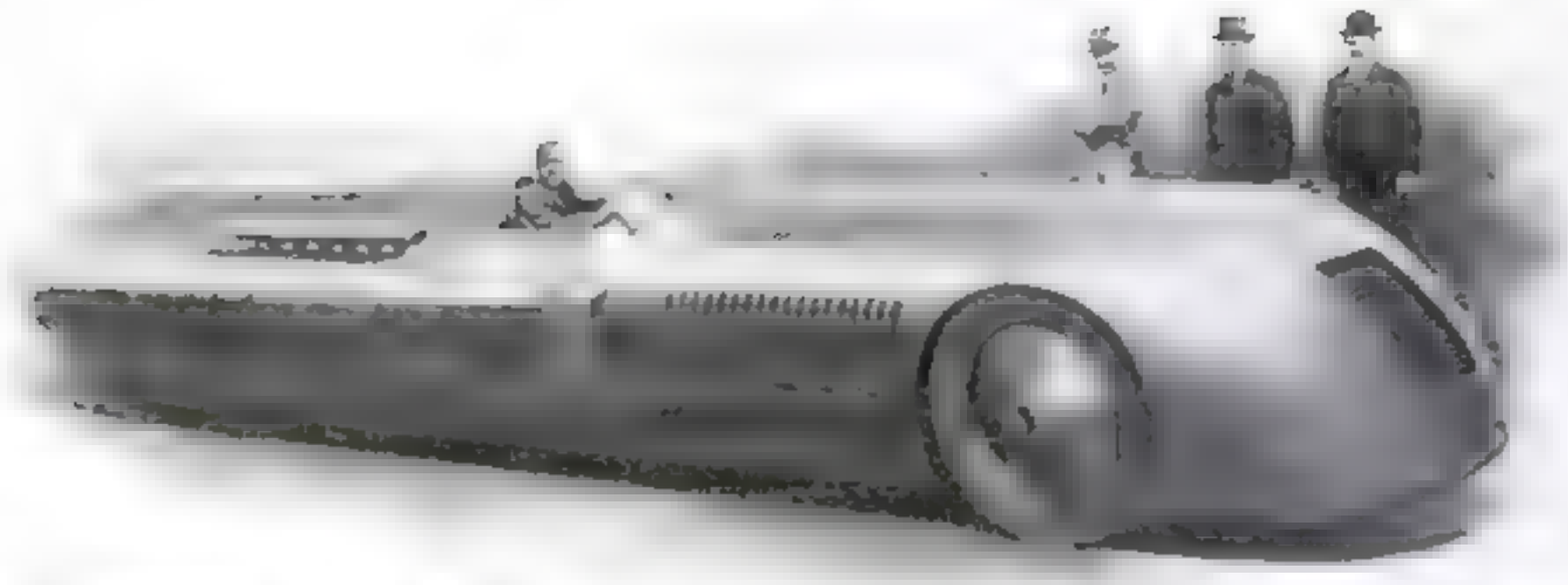
With it in place, the hole in the tire cannot bulge or become enlarged, it is said. The novel needles that grip the casing are thrust through the strip by means of the punch from the inside.

Tests Office Clatter

A NOISY office makes a slow typist, according to Dr. Donald Laird of Colgate University. Amid honking horns, jangling telephone bells and miscellaneous squawks produced by a phonograph five feet from her desk, Miss Esther Heller, expert typist, tapped out endless letters while Dr. Laird held a stop watch.

Her 488 strokes a minute in a quiet room dropped to 488 while the din was going on. Absolute quiet however was not essential, the test showed. Miss Heller lost 27 ounces of weight in two hours of typing when the room was quiet, and twice as much under the strain of the artificial racket.

OVERSIZE shower baths sprinkle trees with artificial rain in California; aerial pipes spouting water replace irrigation ditches where high priced crops are grown and land is expensive. According to Prof. H. A. Wadsworth of the University of California, more yield from the orchards justifies the added expense.



Major Seagrave's 1,000-h.p. mystery car, in which he hopes to travel 200 miles an hour. If he succeeds, to his car will go the coveted title, "fastest thing on land"

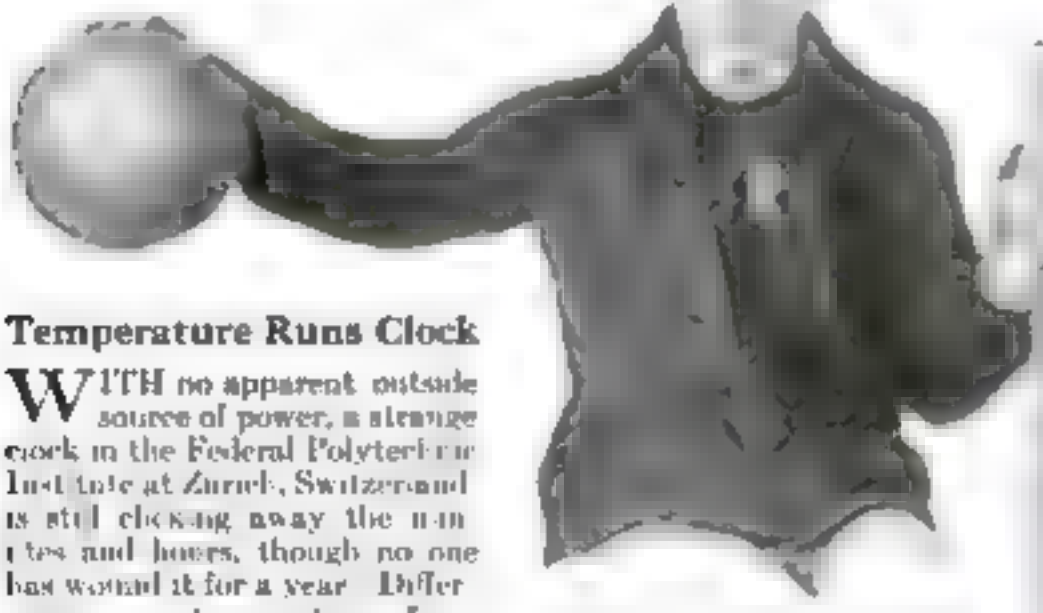
Will Mystery Car Break World's Speed Record on Florida Sands?

WITH this strange dachshund of a car, Major H. O. D. Seagrave, British automobile racer, will soon try to break the world's speed record on the beach at Daytona, Florida. His mystery "rocket" is said to develop a thousand horsepower with its two engines. In a recent road test, it is reported to have exceeded 170 miles an hour. Over the smooth Florida sands, Major Seagrave hopes to pass the 200-mile mark.

The present world's speed record is held by Capt. Malcolm Campbell, who in February smashed all previous official records in driving his 1,450-horsepower Napier-Campbell car over the Pendine Sands, on the Welsh Coast at the terrific speed of 174 miles an hour.

The Biggest Hands in Baseball

WHEN a Californian recently claimed the largest hands of any baseball player in the world, and supported his claim by holding seven baseballs in his hand, Francis D. Foley, a freshman at Holy Cross College, Worcester, Mass., disputed his assertion. In the picture Foley is holding eight baseballs in one hand and a basketball in the other.



F. D. Foley who claims the biggest hands in baseball. Can you beat him?

Temperature Runs Clock

WITH no apparent outside source of power, a strange clock in the Federal Polytechnic Institute at Zurich, Switzerland, is still clicking away the minutes and hours, though no one has wound it for a year. Differences in temperature from night to day run the strange timepiece, the thermometerlike mechanism of which is set in motion by only a two-degree change in temperature. You could put such a clock in your home and forget about it, the Swiss inventor declares. Not only does it wind itself, to run indefinitely without attention, he says, it keeps perfect time in spite of its unusual construction.

Steward Digweed of the S. S. *Asturias* making the electric cow, the marvelous machine which supplies the ship's passengers with creamy milk at the rate of 80 gallons daily

Motor Ship Has "Electric Cow"

FED on powdered milk, unsalted butter and water, the "electric cow" pictured at the left is said to yield as fine milk and cream as any pasture animal. Sixty to eighty gallons of the synthetic beverages emerge daily from its cylinders to feed the passengers of the trans-Atlantic S. S. *Asturias*, one of the world's largest motor ships. Christened Funny and so inscribed by its caretaker Steward Frederick Digweed, the mechanical cow is milked twice a day, to the accompaniment of whirring motors.

Toy Race Track Offers Thrills

AFTER experimenting for years with miniature race tracks of his own construction, Hubert Druce, English actor, has invented a toy horse racing game in which, he says, the winner cannot possibly be predicted in advance. He prolongs the thrill of the race by so arranging his machinery that the toy horses time from start to finish is about the same as in an actual contest, and chance alone, he says, determines in what order the horses will finish, out of more than 40,000 possible combinations.

Hubert Druce, English actor and inventor of the new toy race track, congratulates Ruth Thomas, actress, on picking the winning horse

Marvelous Violin Varnish

DISCOVERY of a varnish that, applied to an ordinary violin, will give it the marvelous tonal beauty of a Stradivarius, is claimed by Quiroga Losada, Parisian violinist. The secret of the musical perfection for which the old master's instruments were famous lay in the varnish he used on them, Losada concluded after years of research. Now the French violinist reports he has perfected a similar varnish that he hopes soon to offer free to musicians the world over, for the sake of art.

I set on violins of various makes, his preparation is said to have made an almost unbelievable improvement in the tonal quality. There are probably not more than forty-five genuine Stradivarius violins now in existence, and those for the most part are treasured and

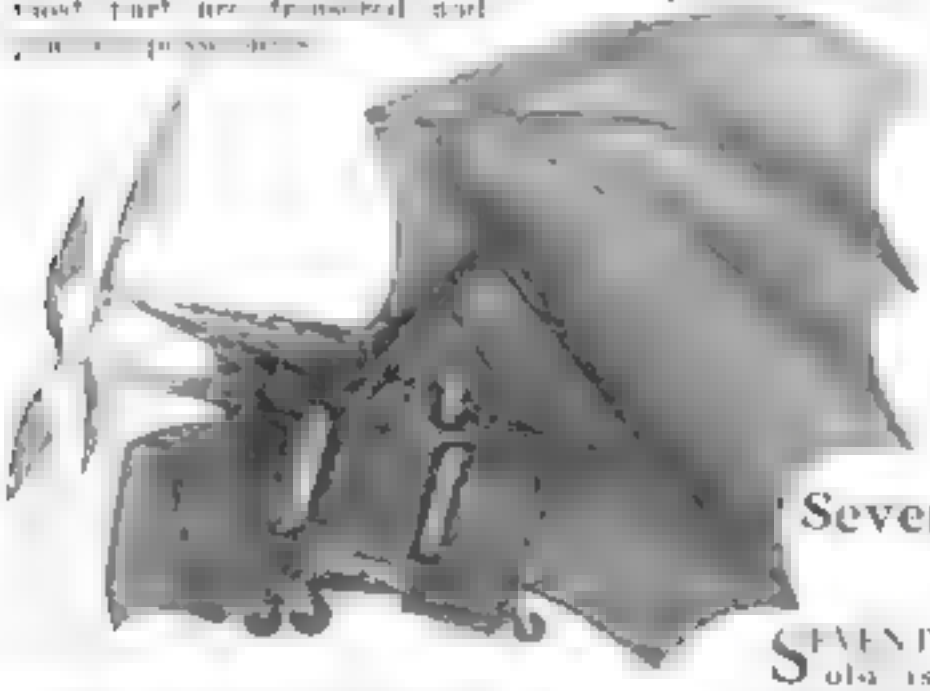
Skiers Learn on Chemical Snow

SO THAT Londoners may practice skiing right at home and be experts by the time their annual holiday in the Britisher's winter paradise—Switzerland—comes around, a leading London department store has installed a real practice slide in its own building. Here enthusiasts learn to ski on an indoor slope covered with a chemical snow substitute that, for the practical purpose of learning the fundamentals of the sport, is said to be every bit as good as the real thing.

Who cares if the weather man is stingy with snow? Not Londoners, who have this artificial snow slide. Here are some of them learning the "kick turn"

Movies Linked with Radio Talk

AN ODD combination of voice and pictures under a new radio system recently amazed an audience in Berlin, Germany. Theatre patrons saw a moving picture thrown on the screen in the usual way, while from a distant radio station came a scientific lecture to accompany it. Synchronization was practically perfect. Previously recorded, the lecture was radioed by an electric motor timed in step with another at the theatre that projected the movies.



Strange Plane Resembles Bat

MORE grotesque than the bat that inspired its design, this amazing airplane, representing man's latest attempt to learn new secrets of speed from the flight of birds, recently made its first trial flight in Paris. Even the propellers are of fantastic construction, though the machine is powered by the newest Blériot motors, of the type designed for commercial airplanes. Vertical fuel tanks surround the narrow cabin from which the pilot steers the odd-looking craft.

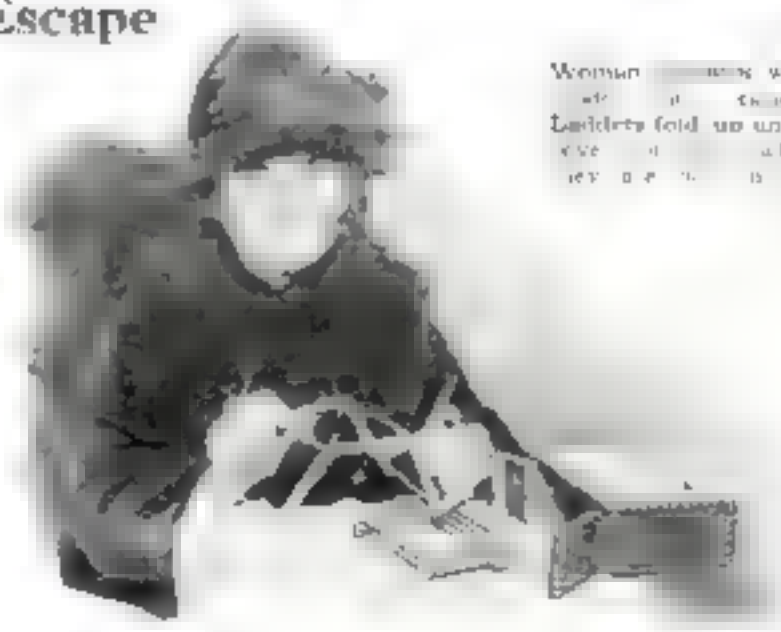
He Makes Wind Run His Clock

STRAY breezes, trapped in a strange windmill with funnel-shaped vanes, supply the power that runs this extraordinary clock. They lift steel balls, 630 in all, which, dropping into a cup on the drive shaft, drive the clock by their own weight. The dropping ball runs down a chute into an elevator operated by the wind, and then is hoisted again into place on the upper track, ready to take its place on the drive shaft. Frank Durnitt, of San Francisco, inventor of the unique timepiece, is adjusting it in the illustration.

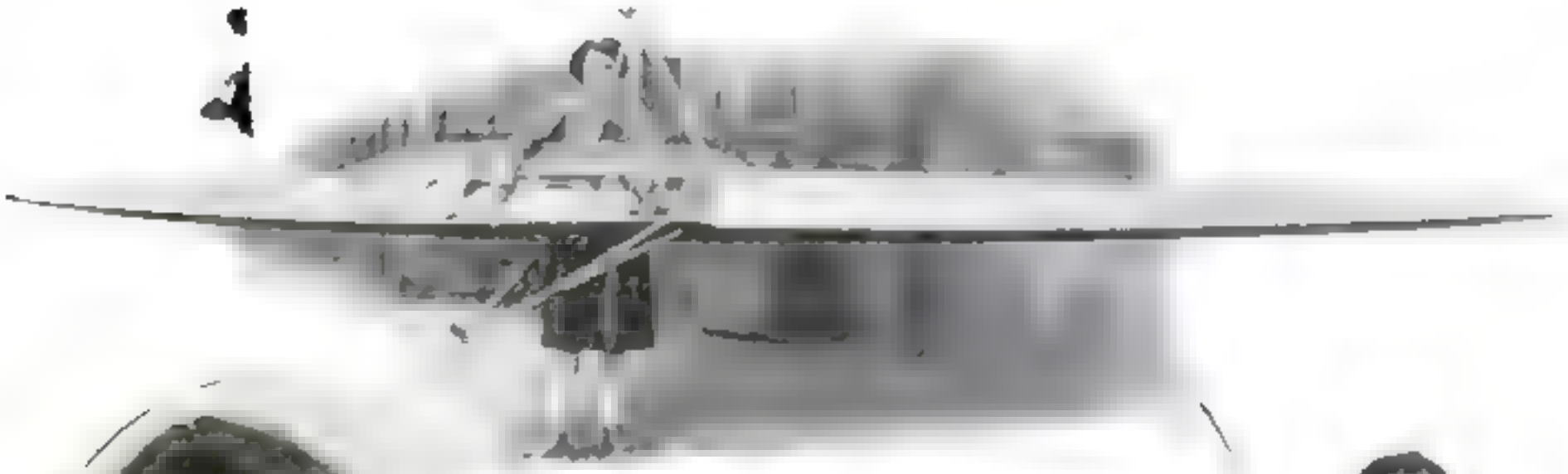
The clock is said to run for five days even when no wind reaches it, and a passing air current will then set it in motion again. Consequently, pictures to prevent there is little reason for the clock ever to stop, as long as outdoor air drives the mechanism.

Seventy-Year-Old Woman Invents Novel Fire Escape

SEVENTY years old is young enough to get ideas new and surprising. Delia Heath of Brooklyn, N. Y. has proved this by inventing a fire escape in the form of a folding ladder fastened on the roof and operated by electricity. When a button is pressed indoors, an arm swings out from the roof and drops the first ten rungs. The other rungs unhinge and follow to the sidewalk automatically.



Woman [illegible] with [illegible]. Ladders fold up under [illegible] when [illegible]



Camera for "Picture Memos"

NO LARGER than a pocket notebook and only two inches thick, the new midget camera above, at one looking, takes fifty tiny but very clear pictures. The cartridges are loaded with regular motion picture negative film, and the pictures can easily be enlarged. The camera needs no focusing, has a telescope finder, and winding is done by pressing a lever instead of turning a key.

KNOW YOUR CAR

AFTER your car has been through a hard winter's service with plenty of driving over frozen humps and in icy ruts, it is a safety first precaution to look it over carefully and make sure that the parts vital to safe driving are in proper condition. Rough going produces an excessive amount of vibration in brake rods and spring shackle bolts, and the steering apparatus suffers under the severe strains imposed on it by running in deep and uneven ruts. Failure of any part of the steering gear is almost certain to result in a serious and possibly fatal accident. Brake failure is nearly as disastrous. Play safe by following these suggestions.

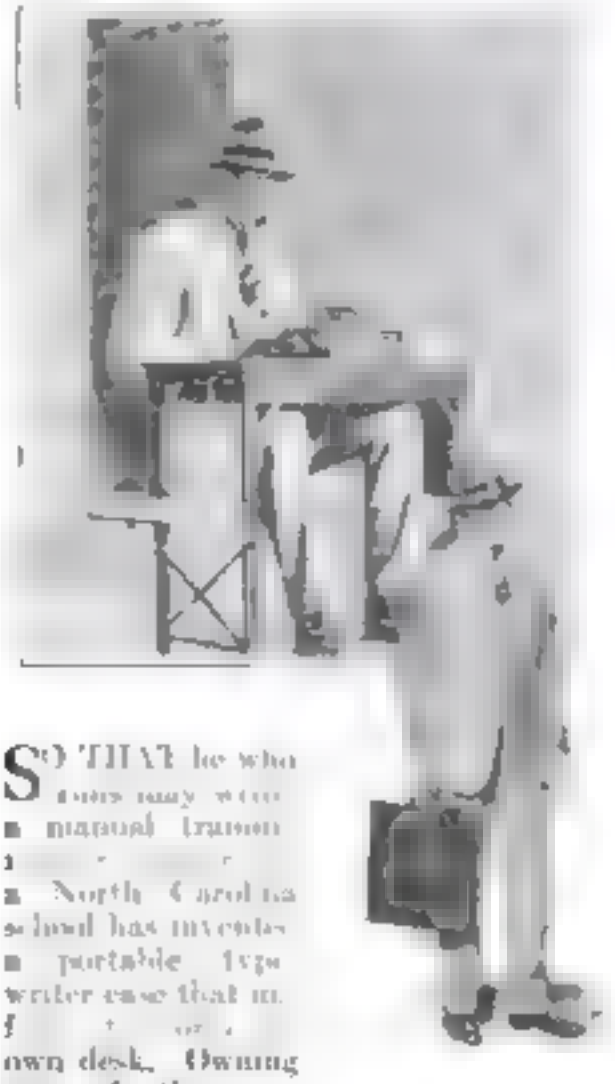
1. **Test the tightness of every bolt, nut and cotter pin in every part of the steering apparatus from the steering wheel to the front hub caps.**
2. **Go over every clevis joint in the brake rods and make sure that all the cotter pins are in place. Replace every cotter pin that shows signs of wear at the sides.**

Racing Shell Built of Metal

SO LIGHT that you could put it on your shoulder and go for a hike, the latest racing shell is made of duralumin, the same light metal alloy that goes into the framework of modern aircraft. Built for the Naval Academy at Annapolis, the new one-man boat weighs only twenty-six pounds, or half as much as the cedar shells in which Navy oarsmen have in the past developed their skill for rowing regattas, and the designer, Walter Hoover, expects it to slip through the water with scarcely an effort.

If he proves right, the Naval Academy will have an eight-oared shell made of duralumin also for the use of its crew.

Invents Typewriter Desk-Case



SO THAT he who uses many words in a manual trade [illegible] a North Carolina school has invented a portable typewriter case that [illegible] own desk. Owning one of these, a newspaper man can type his stories, and a field engineer his reports, on the spot, without waiting for the usual writing facilities. Attached to the legs are compartments for paper, dictionary, data sheets, and postage stamps. Leslie K. Singley, of Hendersonville, N. C., is the creator of the ingenious case, and the photos show it closed and open.

This Gaff Hook Gets the Fish

ONE nibble on a line equipped with this new gaff hook is a fish a-landing for it makes you practically certain of landing him, according to the inventor, William R. Krull of Milwaukee, Wis. Quickly attached to the line after a bite has been felt, the device slides downward, the fish later passing through a loop at the center. Large swinging hooks open automatically to grasp the fish, whose finny body is held securely by its own weight.

Instead of waiting for a fish to take the bait before attaching the hook, it may be kept in readiness by a slip loop released by a tug on the line from a biting fish, or it may be manipulated on a separate line.

Upheaval Lifts Atlantic Cable

CAN you picture a folding of the earth's crust strong enough to lift, in the short space of twenty-five years, an area the size of Greater New York to a height of 11,000 feet above sea level? Such an enormous upheaval took place recently in the Atlantic and was discovered by a mere accident.

Twenty-five years ago a submarine cable was laid across the Atlantic Ocean, passing near the British island of St. Helena, on which Napoleon I spent the last years of his life as prisoner. When the cable was laid down, it rested on the bottom of the sea, about 14,760 feet below the surface. Recently, when it became necessary to repair the cable, it was discovered that that part of the sea bottom had been lifted more than 11,000 feet, which brought the cable within 3000 feet of the sea level.

THE DRONE BEE has 13,800 eyes, the bee who does the work about the hive has 6400, but the queen bee has only 4000, according to Dr. D. A. Sloeum, bee expert of Washington State College.

Chicago Sends Traffic Violators to School

TRAFFIC law offenders in Chicago, after being duly sentenced and fined, are now given the further benefit of class instruction to teach them better observance of the city's traffic regulations. The class above is learning what the traffic lights mean. Those who speed or cut in ahead of traffic are given a few instructive rules.

Machine to "Feel Your Pulse"

HOW you react to surprise, fear, love, liquor, coffee or cigarettes is said to be revealed with scientific accuracy by a new "vitality meter," invented by a University of Berlin professor to record graphically the rate and the nature of heart pulses. Attached to the wrist of the person being examined, a sensitive detector transmits to a recording paper drum every heart action and vibration of the nervous system. Far more delicately can a physician feel your pulse with this machine, it is said, than with his own fingers. Dr. Rudolf Goldschmidt, one time scientific adviser to the Kaiser, is the inventor of the instrument.

Dr. Goldschmidt demonstrating his new vitality meter. The slightest changes in the rate and the nature of the sub ject's pulse beats are charted accurately on the moving tape

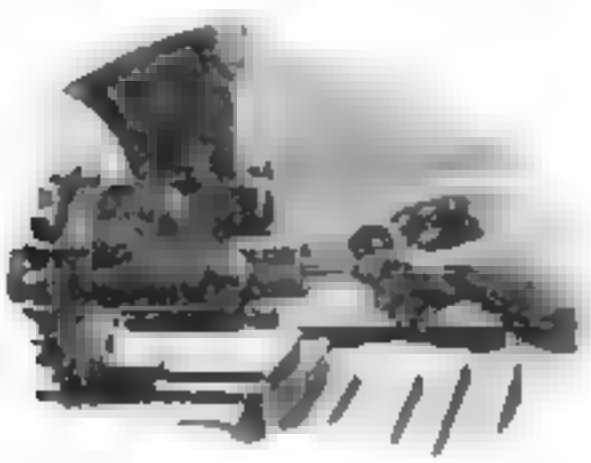
Film Improves Night Snapshots

REMARKABLE results with instantaneous snapshots taken on the cloudiest of days or even at night indoors, are claimed for a speedy new emulsion just announced by a great German camera concern. Used with the ordinary camera, the new film increases the chances of getting good, clear pictures under unfavorable light conditions. Combined with a fast lens, it promises the instantaneous photographing of night street scenes and electrically lighted interior scenes with a clearness of detail hitherto unattainable. The new emulsion is eight times as sensitive as the ordinary film.

Vest Pocket Speed Indicator

HOW fast is that machine turning? Put this novel speed indicator pictured below, against it and you can literally "feel its pulse." Set it to the indicator's side is a circular steel plate that lifts beneath your thumb every time the measured shaft makes a hundred revolutions. Watch in hand, you count the number of pulses during one minute, and multiply by a number set to get in round numbers the total revolutions. Fractions of a hundred turns are shown by a dial on the edge of the device.

The new tool is of small size so that it may be carried handily in a vest pocket.



Counting the revolutions of a shaft—after every hundred, the steel plate lifts beneath the thumb

Police Motorcycle Jack

WHEN this motor cop draws up in front of the station house and shuts off his engine, he bends over and jerks back a clutchlike lever on the right-hand side of the machine. Then he dismounts leaving the machine standing on the two substantial legs that feature a new motorcycle supporting device adopted by Rhode Island and Connecticut police.

Fleet as a greyhound in the pursuit of automobiles, the motorcycle becomes an impediment when at rest. The purpose of this jack is to assist the motorcycle policeman in handling his unwieldy machine when stopped.

Handled as it is from the saddle, the heavy machine cannot slip or fall upon its owner while he is parking it. There is no wrestling match with the motor. When he is ready to depart, the officer swings into his seat, releases a spring that kicks the support out from under him, and speeds on his way.

How Much Do You Know of the World You Live In?

TEST yourself with the following questions, selected from hundreds sent in by readers. The correct answers will be found on page 140.

1. Where do most of the artichokes come from?
2. What state produces the most wheat?
3. Where can the northern lights be seen best?
4. What are the oldest evidences of man in America?
5. Why were the native Americans called "Indians?
6. Where are emeralds found?
7. What national festival is a singing contest?
8. Where are sand storms sometimes encountered at sea?
9. Is the story of the flood found only in the Bible?
10. What mysterious ruins have been discovered in Cambodia?
11. What is copra?
12. What crab breaks coconuts for food?

He Runs His Auto on Acetylene Gas

NOW they're running cars on acetylene in thrifty France. M Jaquemin, a French engineer has discovered that this fuel gas, more widely used for auto headlamps, works admirably as a substitute for gasoline—and cuts his gas bill in two, he says. When he wants to go for a run, he fills the generator slung on the running board with grayish lumps of calcium carbide fuel, turns on a trickle of dripping water that releases the gas by chemical action, and rolls away.

A carburetor of special design mixes air with the unusual fuel to feed an explosive mixture to the cylinders. At the generator, a metal cylinder floating on water keeps the gas at uniform pressure, to issue in a stream when the valve is turned.

Nail Clipper Easy to Use

JUST the slightest pressure on the handle is needed to work this new nail clipper. Its jaws are ground together to insure a clean cut, and a novel system of jointed levers magnifies the force applied.

A file and nail cleaner are conveniently attached, and the device is held closed with a pivoted clip and kept in a case when not in use.

Warm Feet for Traffic Cops

IN BERLIN, Germany, all traffic officers may soon be supplied with their own foot stoves. The plan now being tried out is to place an electric heating device in the glass-covered safety stands which serve as red warning lights at night, but on which the traffic policeman stands during the day.

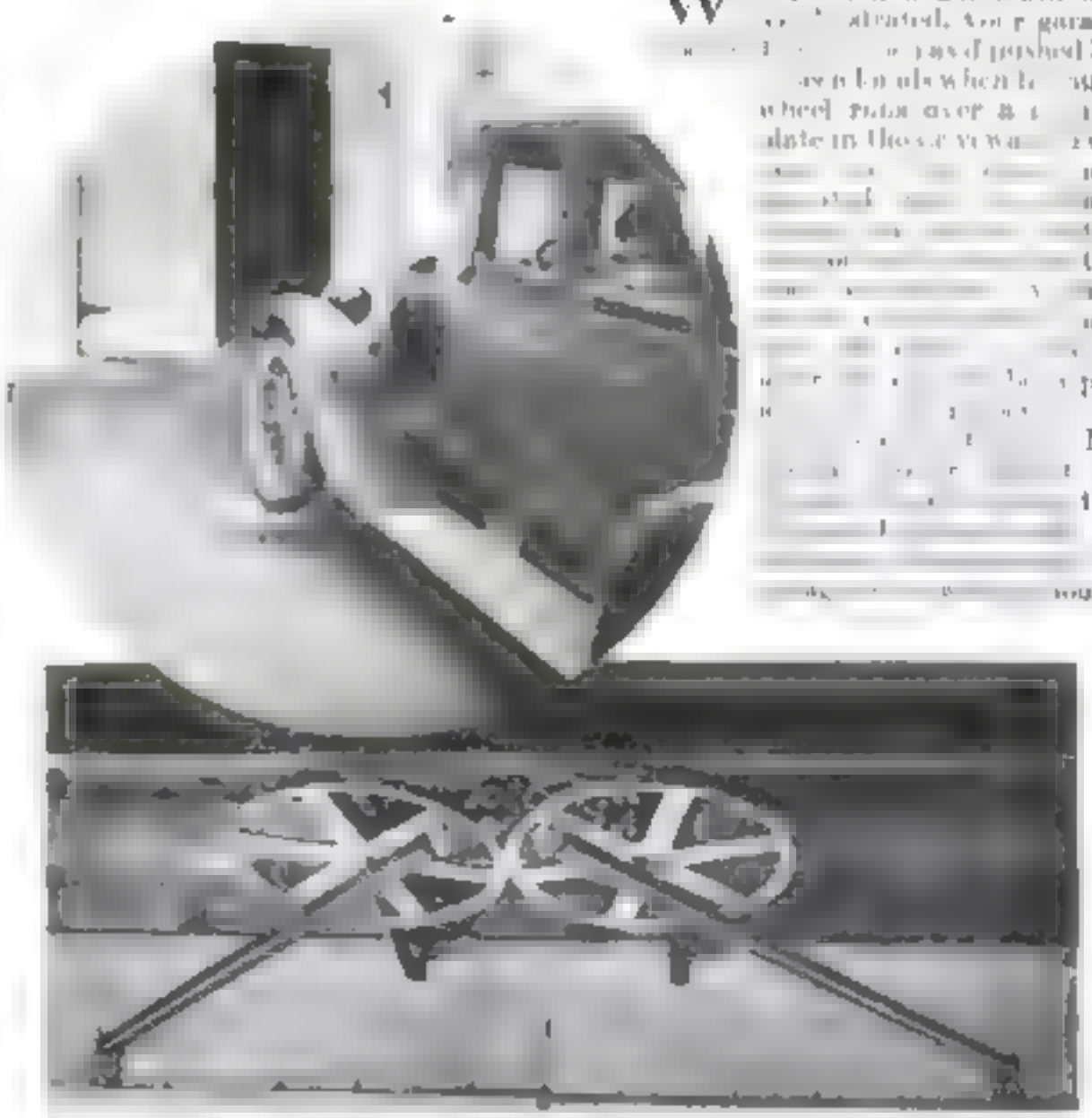
A Record Cut of Douglas Fir

AMONG the largest of its kind, this giant tree fell with a rending crash to top off a record cut of Douglas fir. Special saws of unusual length were required by the mighty girth of these forest titans. Moving them after they had been felled was an engineering problem in itself, and as much cutting as possible was done on the spot.

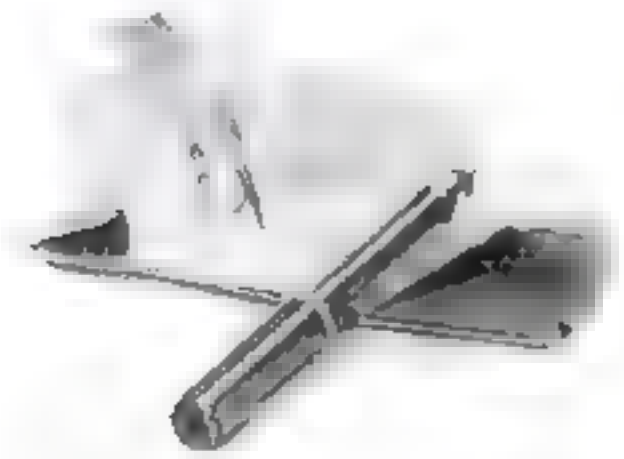
These monsters of the Northwest challenge the reputation of California's redwoods for immense size. Note the height of the massive trunk in comparison with the lumbermen who have labored with saw and axe to fell it.

Device Opens Garage Door Electrically

WITH the new automatic de- [illegible] attached, your garage [illegible] pushed by [illegible] when the auto wheel runs over a [illegible] plate in the driveway. Two [illegible] are [illegible] which the [illegible] push [illegible] per [illegible] pedal to [illegible] No [illegible] is tap [illegible] It [illegible] on [illegible] hours.



Mechanism of the electric door opener—a pair of large gears connected to the doors by rods and rotated by a motor. Above, the ground plate which, under the weight of the car, acts as a push button. The doors are closed by a button in the garage



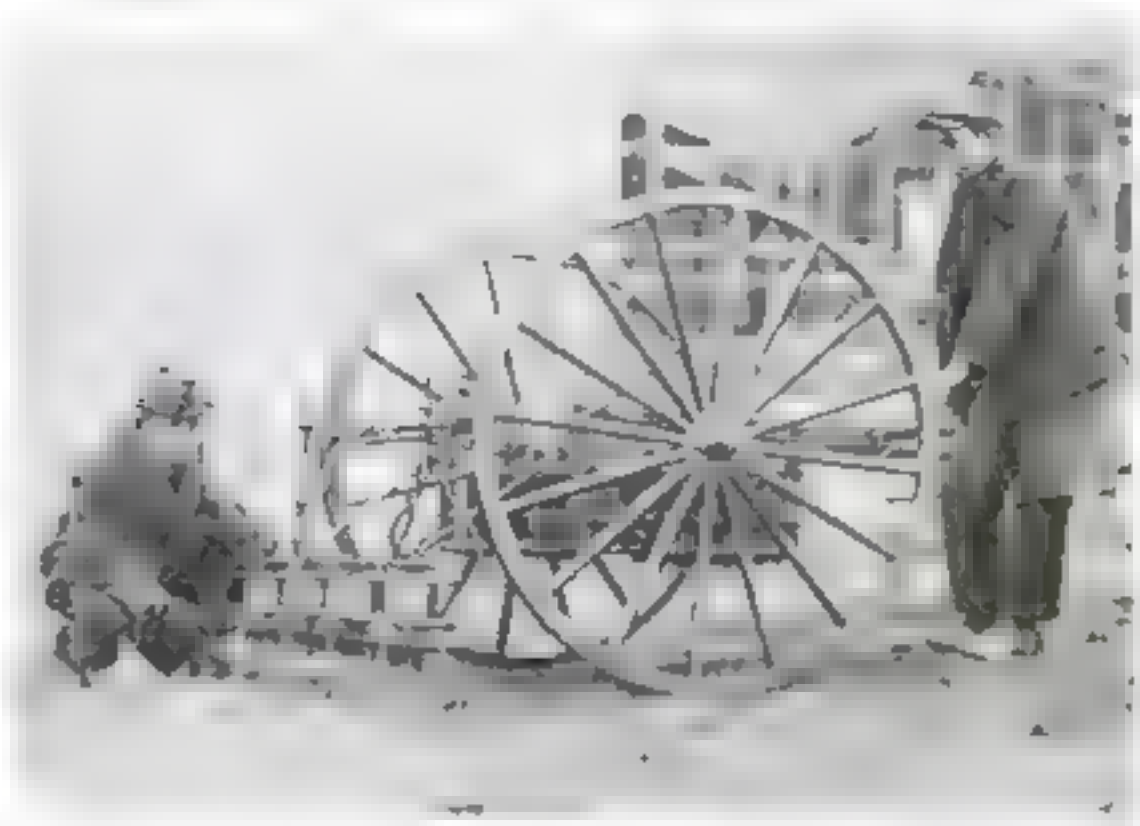
Holds Check Stubs in Place

WHEN you make a fresh entry in your check book the old stubs can't spring back and blur the ink if you have one of these handy holders to keep the pages in place. A curved sheet of metal holds back the leaves, while three prongs keep the device from slipping

New Metal Alloy Found

HARDER than steel or softer than lead, according to the way it is made, is a new alloy reported discovered by T. D. Yensley, London chemist. He calls it salmon, and declares it to be impervious to powerful acids; it may replace platinum, he says, wherever that costly metal is used in industry, on account of its resistance to oxidation and corrosion. It is prepared from oxides of rarer metals

Magnetic Roller Rids Roads of Nails



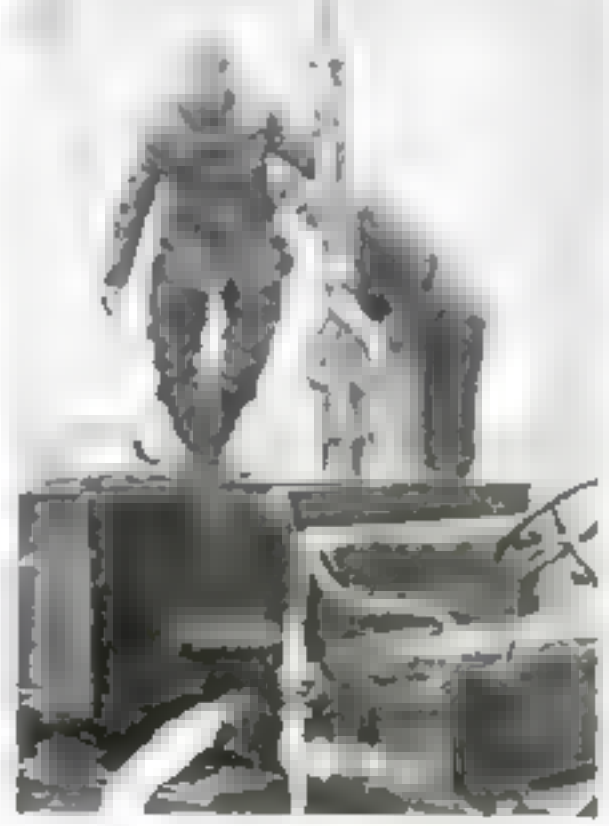
POWERFUL magnets are the latest device used to make the roads of Washington, D. C., safe for motorists. Nails and bits of sharp metal lying concealed in the dust are picked up as by magic when the odd vehicle pictured above, belonging to the Bureau of Public Buildings and Grounds, rolls over them. Electric current reaches the magnet coils from storage batteries carried below the axle, and the accumulation of nails is removed from time to time by the street cleaners who have the special honor of pushing the magnetic roller along the avenue.

In the picture, A. W. Clure of the Bureau, is making a test demonstration of the efficiency of the magnets.

Portable Folding Garage Shaped like Mushroom

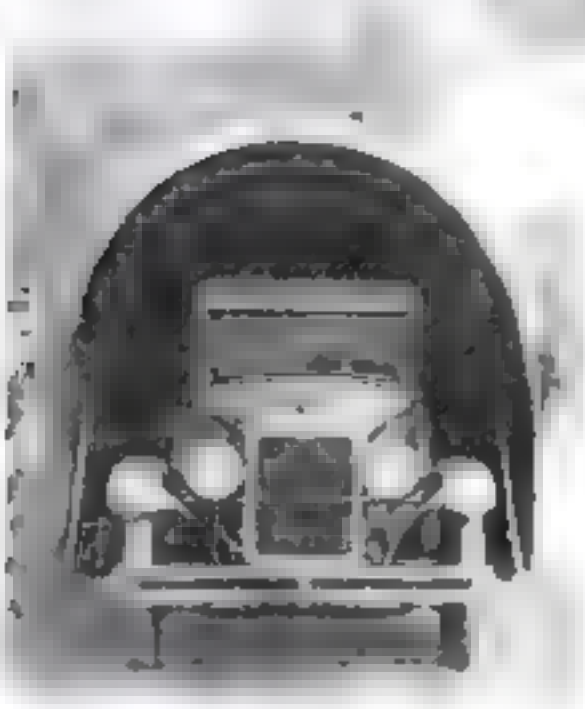
DRIVE up to this novel portable garage, raise a handle, and the entire front half will slide up so you can run the car inside! A pull on the chain hanging from the handle closes it again.

Made of two steel sections that telescope into each other, as shown in the two pictures, the garage reduces folding construction to its simplest terms



Mightiest Land Fire Engine

CAPABLE of shooting a stream of water nearly twice the height of the 223-foot towers of Notre Dame Cathedral, a new fire engine, latest acquisition of the Paris fire department, is the most powerful land fire-fighting machine in the world. From a distance of two thirds of a mile it can, if necessary, pump the water that it hurls in torrents on a blazing building. Only the fireboats of New York and London can surpass the jet thrown by this mighty machine, the force of which is such that two men are required to handle the nozzle. The pump itself weighs six and one half tons.



Tiny Plane for Submarines

IN THREE minutes a tiny new French seaplane, said to be the smallest in the world, can be assembled piece by piece on the deck of a floating submarine and made ready for flight, according to reports. These planes will be carried by every submarine in the French Navy They are said to rise from the water in nine seconds, and a few minutes later to attain a height of two thousand feet As quickly taken apart as assembled, the portable plane is to aid the submersible craft in reconnaissance in time of war.

Practical New Inventions

Noninflammable Fuel Device to Eliminate Liquor Test,

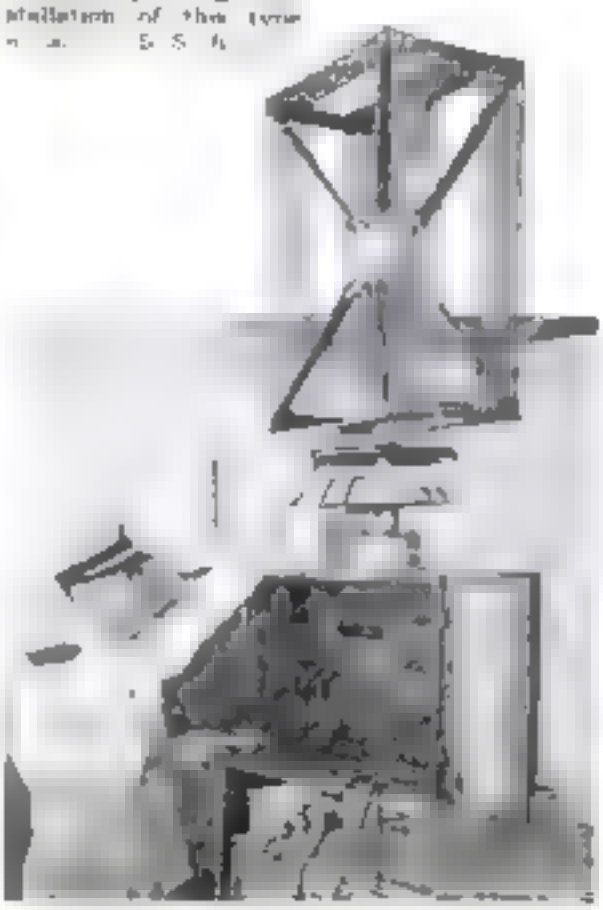
Testing poison liquor is the newest use for ultra violet rays. In the device pictured above, invented by Prof Donald C Stockberger Massachusetts Institute of Technology if certain rays show up in a spectroscopic examination, the suspected liquor will prove fatal or injurious to the health of the drinker

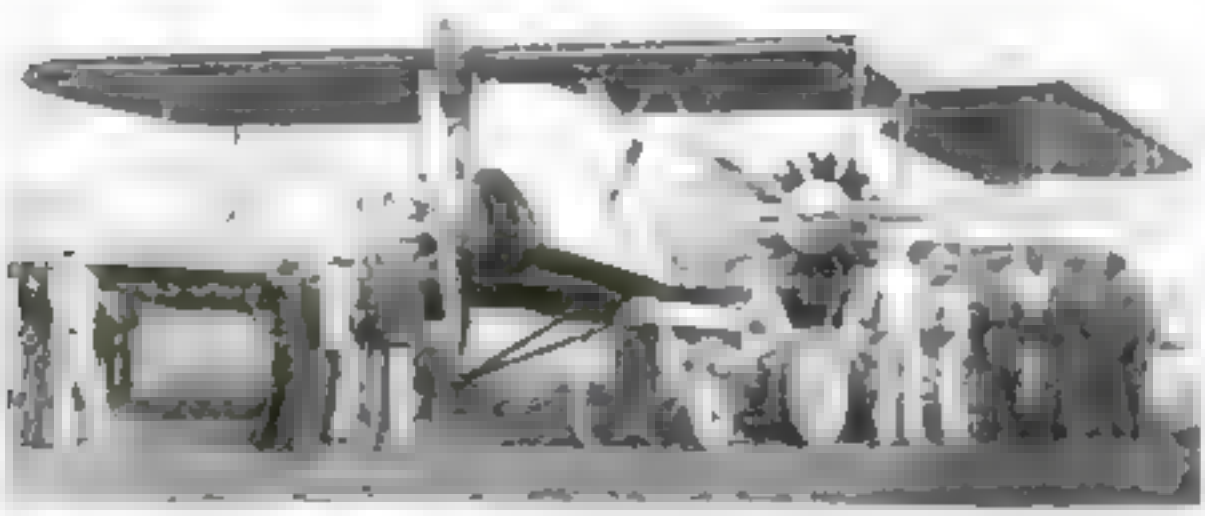
To facilitate and safeguard the work of the airman, a manufacturer has developed this ingenious platform that climbs at any desired position on the pole by means of a strong chain as shown. A safety belt, also, is provided

A [illegible] propeller [illegible] which is driven [illegible] engine. The [illegible] Navy engineers. Two [illegible] are [illegible] Wrecks resulting [illegible]

Rear Admiral Moffett and Paul Davis [illegible] Akron [illegible]

The U. S. Navy is making experiments with radio compass stations to predict storms by measuring static manifestations. Lieut Minter, below is operating an installation of this type [illegible] U. S. N.



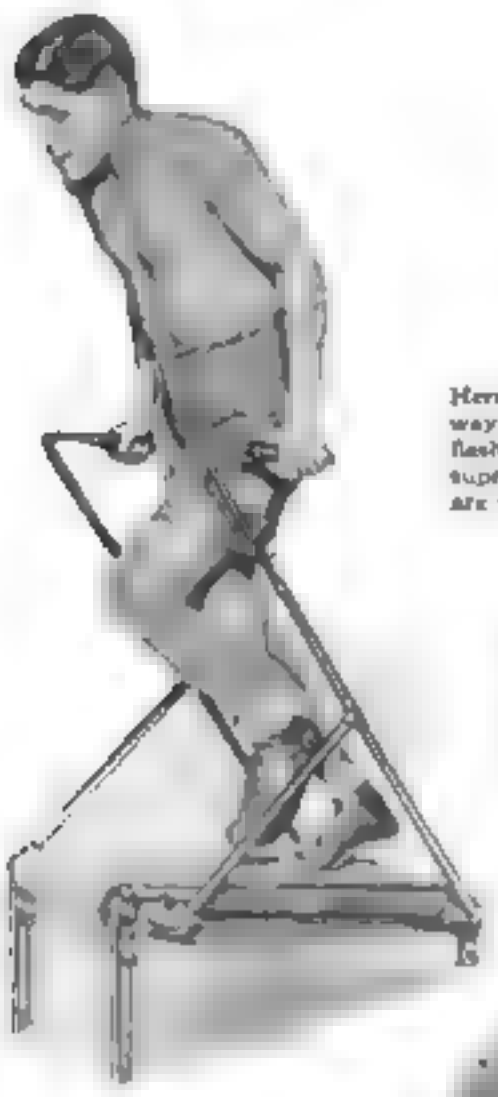


The remarkable new bombing and torpedo-dropping plane adopted by the U. S. Navy. Its wings fold backward like a bird's, so that it can be carried in small space on battleships

Born *of* Human Needs

for Airplanes, Radio Batteries, Poison Other Devices

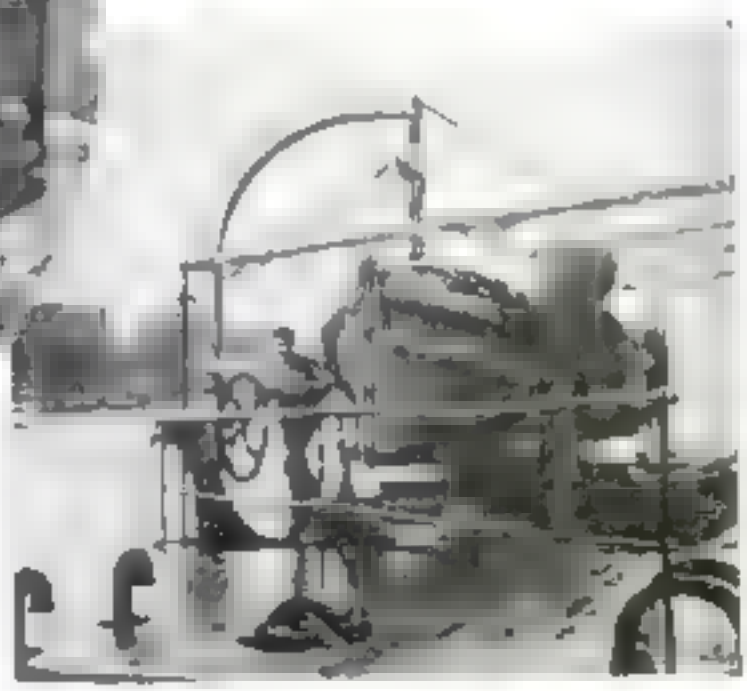
Here's how they keep tab on an elevated railway system in Chicago. Red and green lights flashing on the huge diagram in the power supervisor's office tell him what power stations are working, and he can stop any train at will

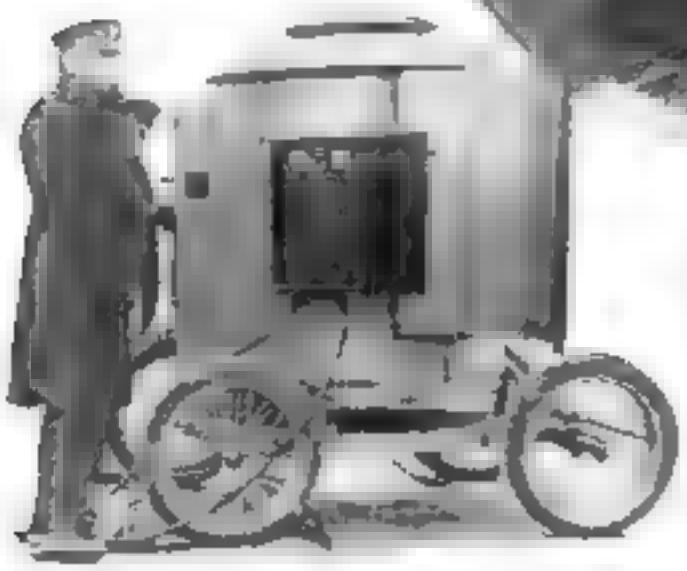


For training prize fighters, the Observatory Boxing Club, San Francisco has this novel machine which gives the boxer nearly the same result as road work. A heavy canvas belt, mounted on rollers under his socks the runner's feet

Batteries and vacuum tubes in radio sets may become a thing of the past with this amazing invention of Dr. Palmer H. Craig of Cincinnati. Bismuth plates, it is said, generate the energy to operate the radio set, and serve as detector and amplifier

(Right) Carl Robert Blum, German musician, has invented a machine for graphically recording on a film all the delicate vibrations that make up any type of musical composition. Such records are a big help in the study of composition and technic, it is said

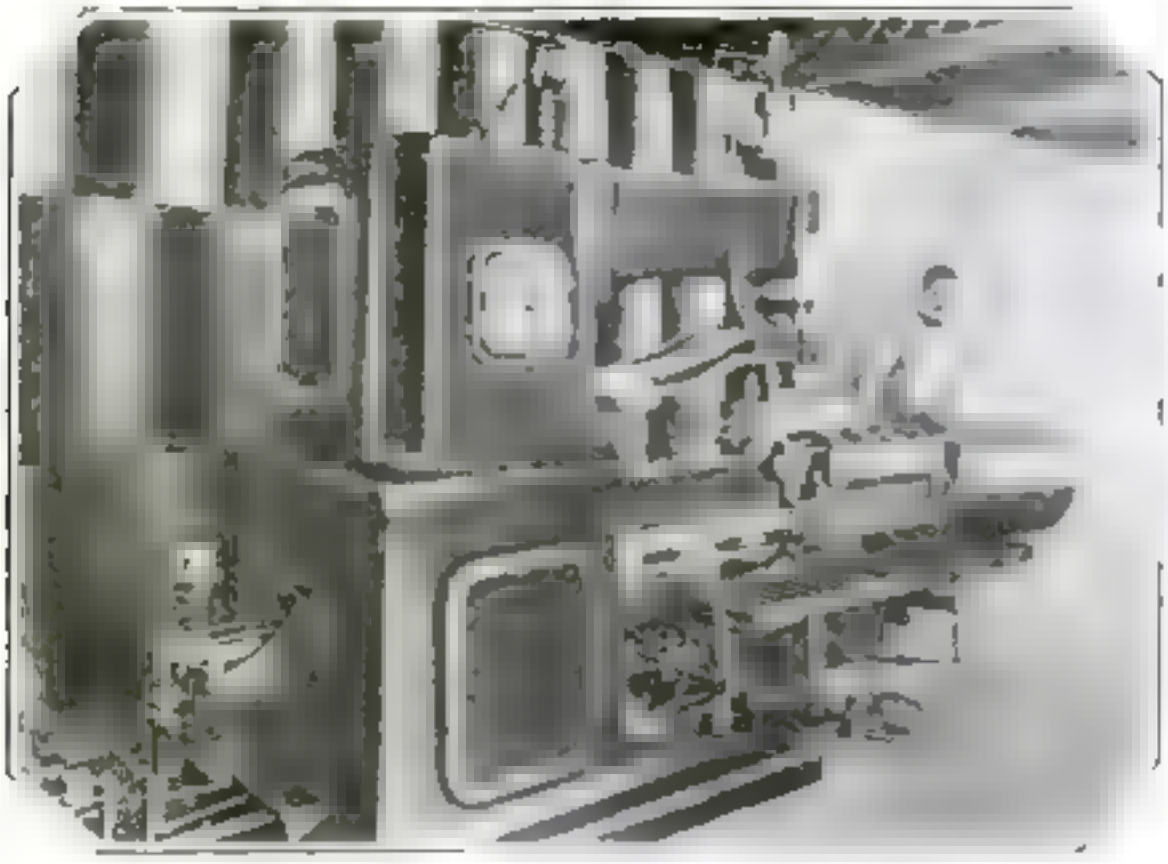




With a five-million-candle-power beam concentrated along the ground, and mounted on wheels, a new portable floodlight at Anacostia, D.C., aids night landings for Navy planes. If it proves satisfactory, similar lamps will be installed at all Navy flying fields

Basket-covered lifeboats, their horizontal bulges filled with cork, are being tried out on the steamship *Castalia* of Rotterdam. The cork gives buoyancy, while the springy basketwork is to prevent damage to the boat during launching

It Sews Seams with Liquid Metal Stitches



TEA kettles, pails, milk cans and automobile bodies are today sewn together at the seams with liquid metal by new welding machines that remarkably resemble the sewing machine in operation. As in a sewing machine, the metal sheet with edges overlapped, is fed between two rolls, and an electric current intercepted a thousand times a minute deposits spots of metal that serve as stitches to bind together the lapped metal. These spots merge into each other, making a continuous joint.

"Business as Usual"

WHILE workers recently tore down the apartment building that had housed it, and literally left it without a roof over its head, a New York City bank continued to do business as usual. Even after the structure had been completely razed, depositors found the bank still standing in a corner of the excavation. Its walls and plate glass front gone but protected from the elements by a light wooden framework and a covering of tar paper. Here as pictured below, it was enabled to carry on until the huge new housing was built around it.

Harry Houdini runs a cigarette case, a movie projector patented by a Swiss would permit you to carry a pocketful of movies, to show your friends as easily as snapshots. Run on a flashlight battery it holds twelve feet of ordinary film. Special films will give a longer picture.

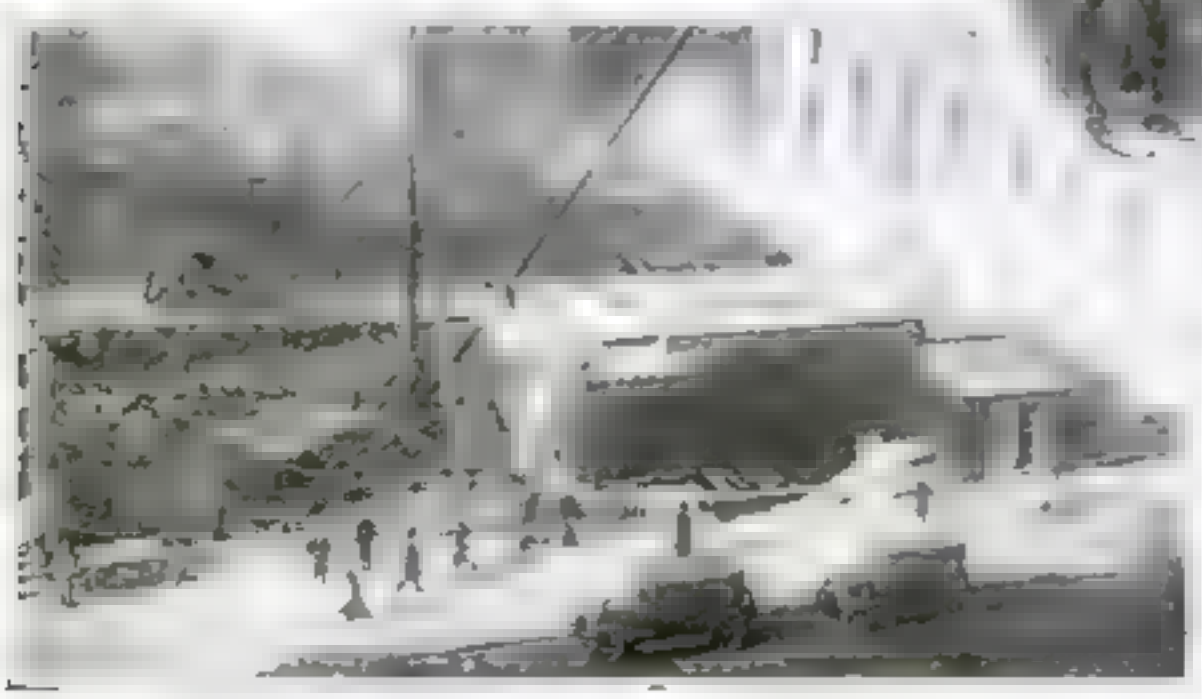
Phone Silencer Guards "Asides"

ARE you accustomed to holding your hand over the telephone mouthpiece when you converse "aside" with other persons in the room? A British inventor decided that that was old-fashioned and, besides, not quite polite, so he devised a new silencer that fits between the transmitter. When you wish to talk into the phone a lever is pushed to "speak," or the dial for private remarks not intended to be heard at the other end, and the lever is moved to "silent," and the telephone becomes deaf for the time being.

Puffs of Smoke Add Realism to War Map

SURVEYED through field glasses that make it appear miles away, a novel war map at Princeton University makes artillery practice realistic to students of the Princeton unit of the Reserve Officers Training Corps. Chemical smoke puffs represent exploding shells, and spots of color indicate villages on an apparent four square miles of terrain as each student takes his turn at directing the imaginary barrage.

The ingenious map is operated by the instructor, who follows the student's data and commands to fire. A small adjoining map is criss-crossed with lines



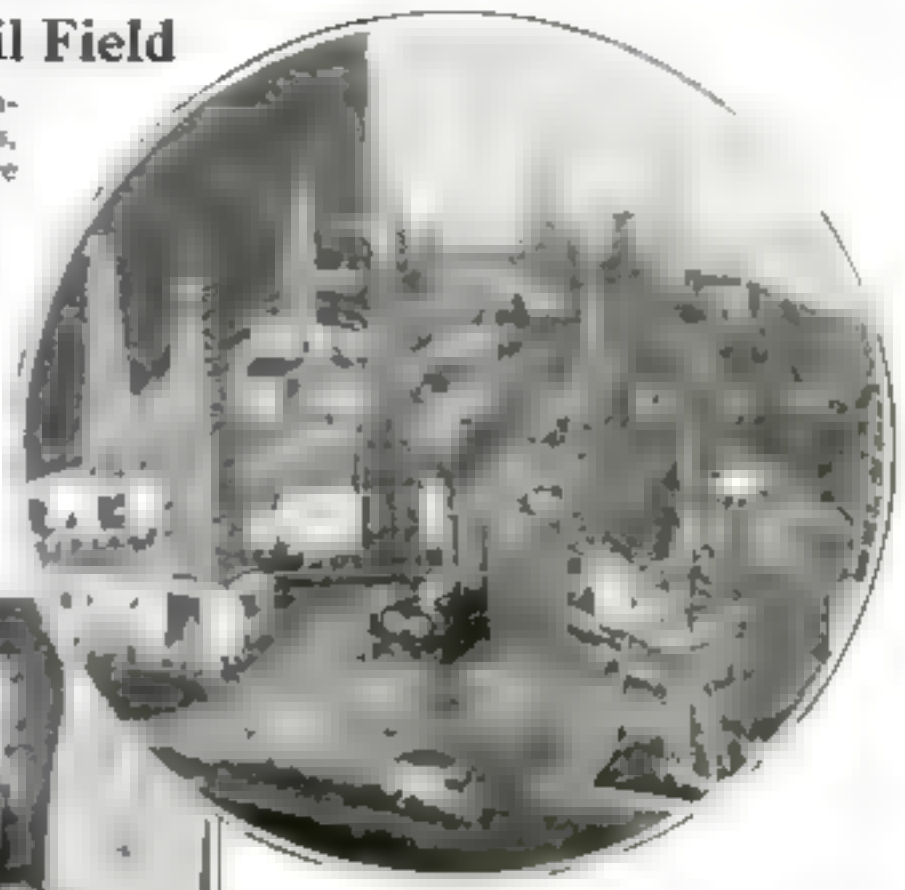
Major F. B. Inglis demonstrating the realistic war map to students of gunnery at Princeton

showing where shells with various ranges would strike. Over this key chart moves a lever which, poised at the spot where the student's shot would fall, swings a glass nozzle to a corresponding position on the large map; at the student's word "fire" a puff of artificial smoke is released. Following "shots" revise the range.

Amazing Model Depicts Entire Oil Field

A RECENTLY constructed masterpiece of model making, made in California, depicts in miniature every phase of the entire oil industry. It covers an area twenty feet long and is divided into four sections—the wells, the refinery, transportation, and uses in daily life. The picture at the right shows the first of these sections, the wells. The transportation section shows oil boats in docks and huge oil tanks; the "uses" section shows, mainly, an automobile speedway.

Sparkling life is added to the model by action—a real well gushes, a lighthouse flashes, and automobiles race around, connected to a belt concealed underneath by means of a link extending through a narrow slot in the miniature roadway. Gasoline filling stations, even a tiny model of an airplane, show uses for oil.



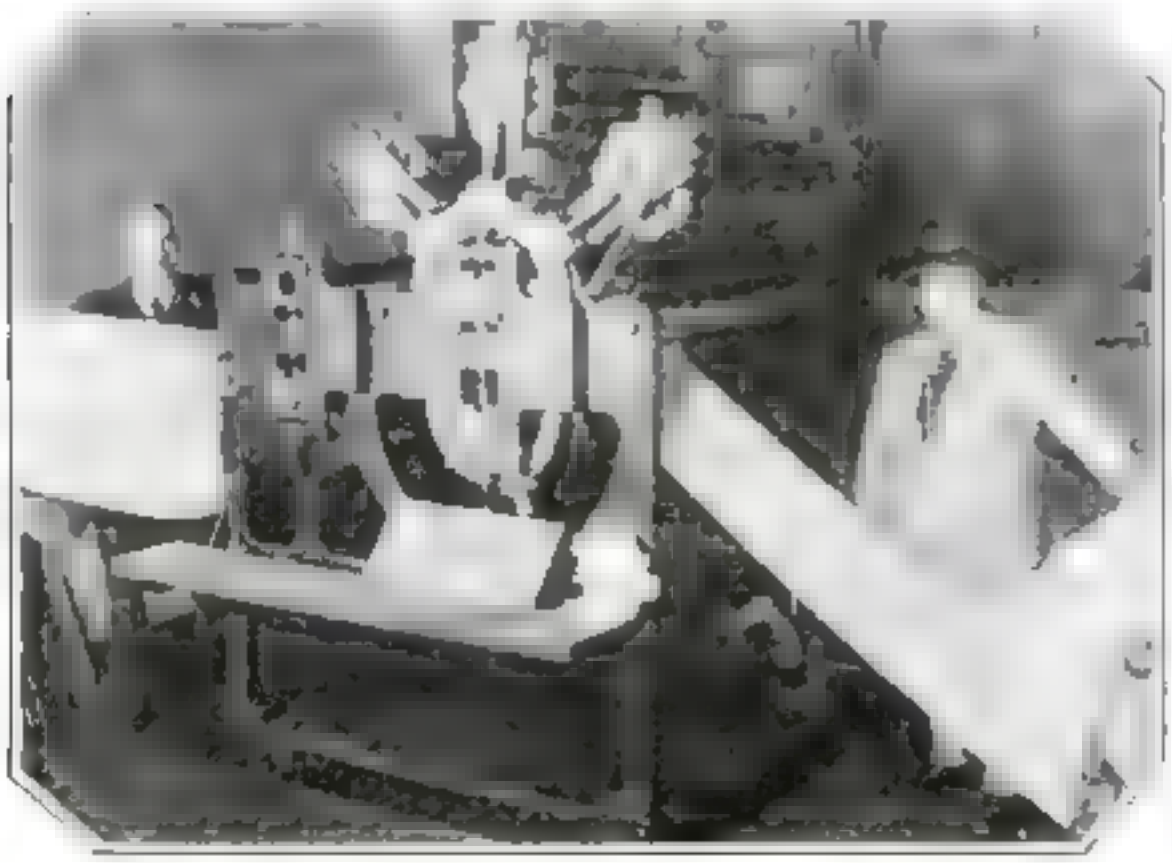
An oil field in miniature. Note the tiny figures of workmen going about their various jobs

Their School's a Railway Car

IN THE sparsely settled districts of the province of Ontario, Canada, where few permanent schoolhouses have been built, classes are held in specially equipped "school trains," as above, that regularly make the rounds of the district. The locomotive parks the "school" in a siding and another car attached to the train provides complete and comfortable living quarters for the traveling teacher.

New Machine Prints, Scores and Cuts Cartons

CARTONS to hold your groceries, cigarettes or electric light bulbs are whisked out of the remarkable machine below at the amazing rate of 1200 a minute, stamped complete with their colored designs. Using a roll of paper instead of flat sheets, according to its Minnesota inventors, eliminates waste at the irregular ends of the carton. A one-man machine, it combines all the steps in printing and cutting a carton. In the picture the paper roll stock is seen entering the machine at the right, and leaving at the left, printed and cut.



Hooks to Hold Scaffolds

HUNG from the ingenious bracket pictured below, scaffolds are safely and quickly swung into place, according to its maker. The new invention firmly grasps an upright pole, clamped by its own weight alone, and makes lashing with rope unnecessary. From its U-shaped hooks scaffolding is then suspended in a few moments. An aid to high speed building, the device has been used in Government housing projects.

Placing the bracket on a scaffold pole ready for a cross bar to be dropped into position

Now—Gold-Plated Cloth

IN AN amazing new process of electroplating reported from Germany, the object to be plated is subjected to a bombardment from a filament of gold or silver in an electric vacuum tube. Speeding atoms of precious metal dislodged by the electric current are hurled across the vacuum, to attach themselves with terrific force to any object which is placed in their way.

Anything at all can thus be plated, it is said—metal objects, wood, even cloth.

Device to Burn Small-Size Coal

NOW you can burn smaller coal in your furnace, at a tremendous saving, according to Dr. W. A. Noel of the U. S. Department of Agriculture. Government scientists have perfected a device that, placed in the fire box, creates the strong draft needed to burn "buckwheat" coal. Without this, the small lumps would smother the fire, as they pack together more closely than the large sizes you are accustomed to use.

Hollow tubes with holes punched at intervals release streams of air in the midst of the bed of coal. Heat from the fire produces the draft.

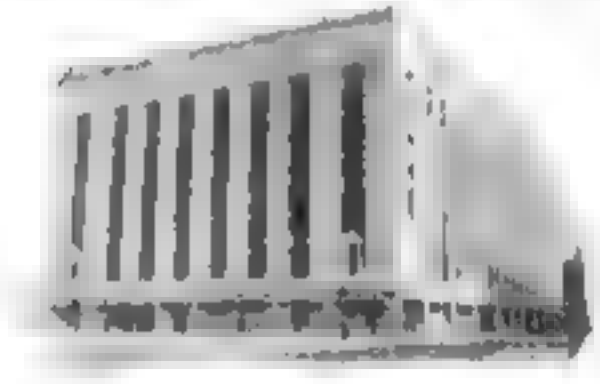
Dr. Noel with the new coal burning device, designed to be placed in fire box

Seasick? Try Oxygen

OXYGEN is the latest cure for seasickness recommended by German physicians. When the gas is inhaled for three or four minutes, they say, the seasick person is immediately relieved, and even nausea ceases. Explaining this remarkable cure, the doctors declare that the illness is caused by an anaemic condition of the brain—a condition that oxygen is said to remedy.

Now the "Skyscraper" Garage

IN THIS modern home for the cars of Boston motorists, you can park your car eight stories above the street! The new structure is that city's answer to the cry that modern tall buildings, housing thousands of workers in their many stories that rise from a limited ground space, aggravate the traffic problem by giving the cliff-dwellers no room to park their cars, with consequent congestion of subways and other transportation lines at closing time.



Provides parking space for 2,000 cars

New Boston is turning the tables by applying the skyscraper idea to garages. Parking space for two thousand cars is provided on the eight floors of this garage.

12-Year-Old Bird Sets Record

HOW long can a bird live? A new official record for long life among the feathered tribe has been set by a twelve-year-old pintail duck captured near Brawley, Calif., according to the Biological Survey of the U. S. Department of Agriculture. Attached to the bird's leg more than twelve years ago, at Bear River Utah, by a member of the Bureau's scientific staff, a dated band proves the record authentic.

The longest previous record was that of a stork that carried a band of the Rossiten Bird Observatory, in Germany, for eleven years.

Of the immense number of birds in this country which are yearly handed by the Survey in the difficult attempt to obtain this information and other valuable data more than three thousand were captured or shot and their bands returned to the Bureau last year to aid in the research. The recovery of banded birds, says the Survey, also throws light on the remarkable distances traveled by migratory birds.

Fight Deer with Moth Balls

MOTH balls are the latest weapon that mountain fruit growers in New York are using against herds of wild deer that despoil their orchards. Loath to kill the animals, local dwellers are heeding the advice of state game wardens that moth balls are just as distasteful to deer as they are to moths.

Scientist Offers New Theory of Earth's Origin

THAT the earth was never a gaseous nebula but attained its present shape and size by the collision and fusion of cooled particles buried from our erupting sun is the amazing theory now said to be confirmed by Prof. T. C. Chamberlin of the University of Chicago. "The earth grew out of a solid core," he asserts as a result of his twenty-two years of study.

Known as the "planetesimal hypothesis," this explanation of the earth's origin has interested astronomers for years. It explains the sun's volcano-like eruption that hurled the earth into being as due to the gravitational disturbance when some vagrant star, tentatively identified by Dr. W. J. Luyten of Harvard Observatory as the star "40 Taun," approached sufficiently close.

Professor Chamberlin declares that the earth's irregular, unsymmetrical shape shows it was built in this way. Volcanic studies have proved to him that erupted matter shows the same characteristics as does the earth on a large scale.

Wealth in Abandoned Ore

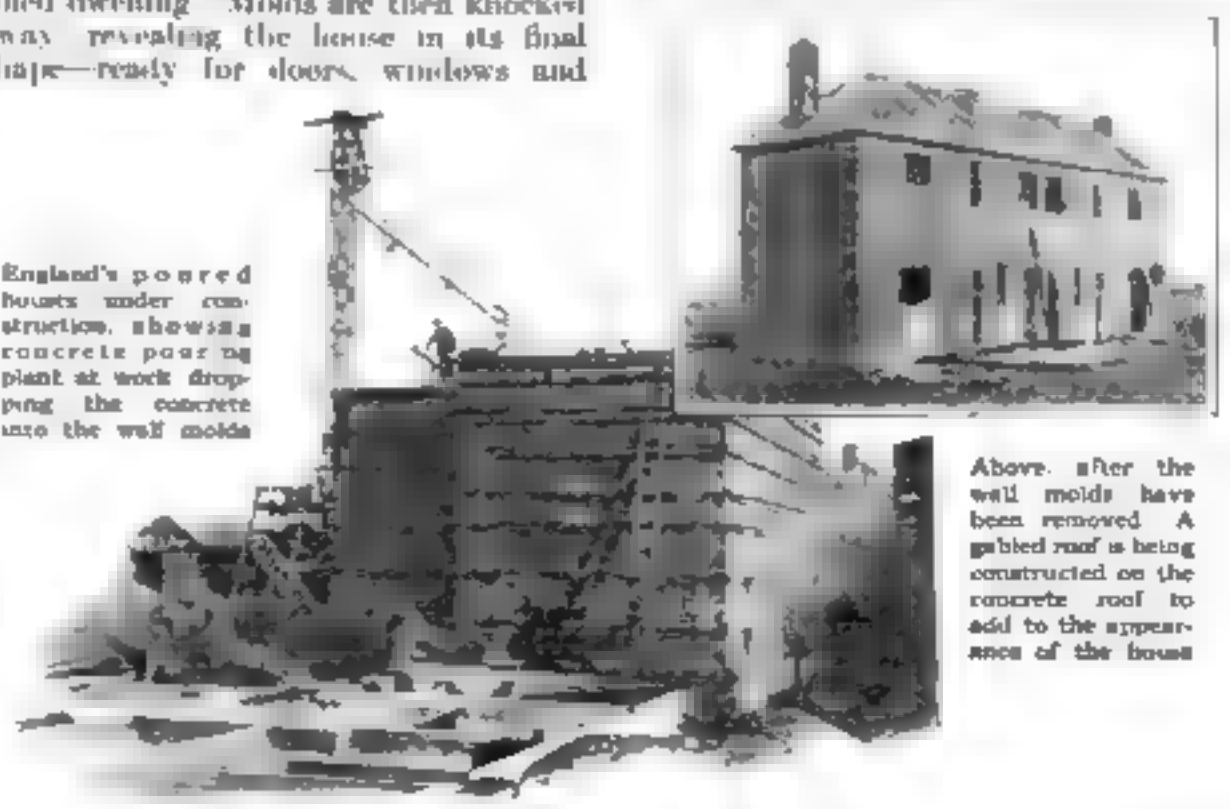
ONCE a mountain of pure metal—then abandoned when its supply ran low and other mines were discovered—now Iron Mountain, a picturesque beauty spot in the Ozark range of Missouri is to ring again with the clatter of drills and hammers. While its phenomenal supply of pure metal lasted, lower grade ore was wastefully dumped and left untouched, though it contained from twenty-five to forty percent of iron. Now this dump and the old shafts are to restore iron mining in Missouri after a quarter of a century.

Joseph Pratte, a French prospector, accidentally discovered Iron Mountain

Houses "Poured" in England at One a Day

WHEN Edison foresaw houses of molded concrete, poured at one stroke, his dream was nearer realization than he thought. At Leicester, England, the amazing scheme has been made practicable. Into a built-up casing, concrete flows to take the shape of the finished dwelling. Molds are then knocked away, revealing the house in its final shape—ready for doors, windows and roof to be fitted. Two houses in two days is reported as the pace of the builders.

After foundations have been laid, each of the standard mold sections is set in the place its lettering designates. Machinery hoists concrete to the top of a steel tower, to drop it into the molds.



England's poured houses under construction, showing concrete pouring plant at work dropping the concrete into the wall molds

Above, after the wall molds have been removed. A gabled roof is being constructed on the concrete roof to add to the appearance of the house

Talking Movie Camera "Photographs" Sound with Pictures

IN THE latest talking movie process, known as "movietone," Fox-Case use of New York believe they have achieved the utmost in amplification. Both pictures and sound are photographed by a single camera. Within the camera, a glowing violet lamp of new chemical composition prints on the film margin voices picked up by a microphone. For the theater, a special projector will take either the new films or the "vitaphone" records made by an earlier process. Mounted directly behind a screen on which an audience sees the pictures, loudspeakers make voices appear to come from the actors' lips.

Wants Bright-Colored Buildings

BLUE or green buildings may some day replace the drab structures that line our city streets, if the vision of color in architecture seen by Leon V. Solon, chairman of the Architectural and Allied Arts Exposition at New York City, comes true. It is important, he says, to choose colors that will have the best psychological effect. For Wall street, in New York's financial district, he suggests "a soothing green" to quiet nerves subjected to constant excitement. Blue, he agrees with others, is probably the most restful color.

Properly used, Ely J. Kahn adds in concurring with Solon's theory, colors for buildings will not seem bizarre. They will blend with the landscape and pass unnoticed except for their pleasing effect.

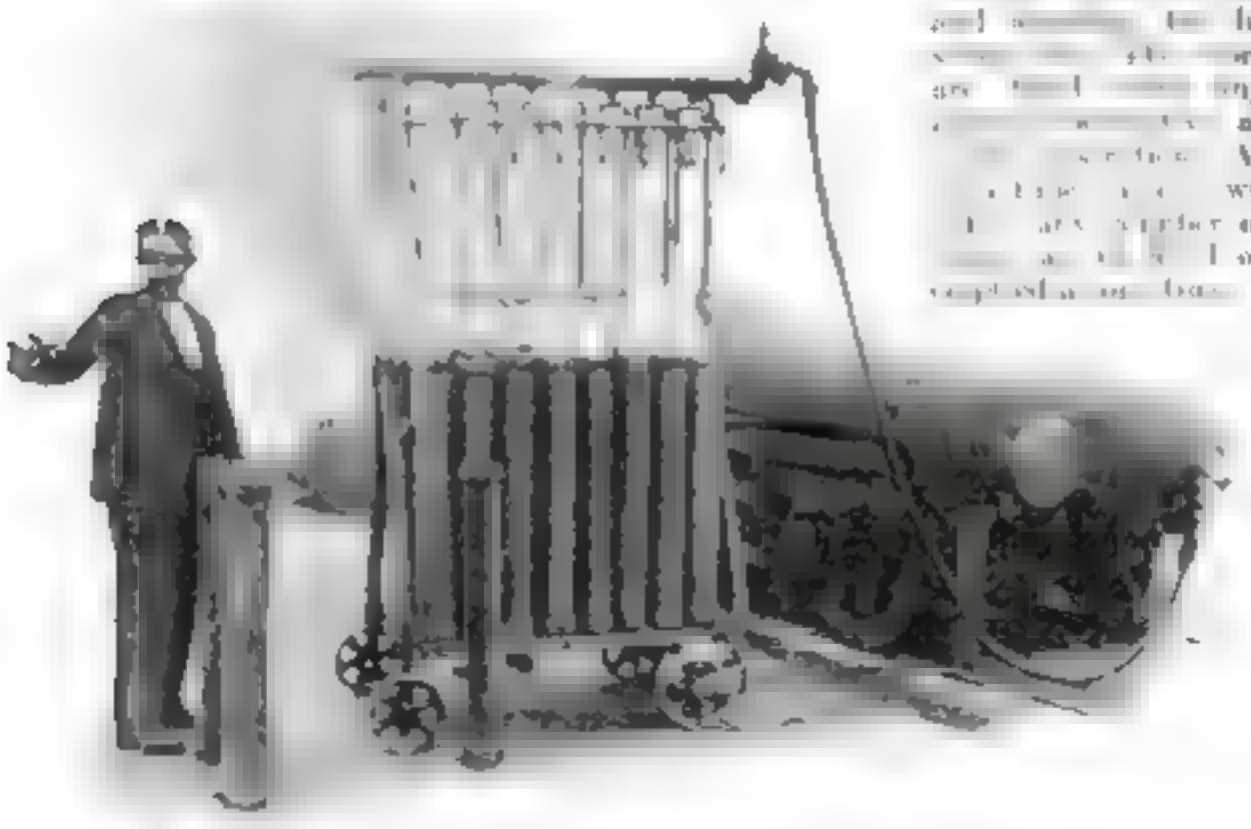
Pupils paddle in boats around the coastlines of this unique map

Outdoor Map Covers Garden

NEWEST scheme to make geography attractive to young folks, a unique outdoor map of Europe being constructed in a garden near Paris will have seas on which they can paddle about in boats. According to P. Hopkins of Santa Barbara, Calif., designer of the map, the concrete coastline will give an accurate and instructive picture of Europe's face. A corner of the map, showing the bootlike peninsula of Italy to the foreground with the island of Sicily at the left appears in the illustration—still incompleted, of course.

"Canned Heat" for Italy's Railway Trains

A NOVEL idea has just been introduced in Italy—"canned heat" for railway trains. When passenger cars are left standing in the cold without an engine, steam is delivered to them from a portable set of small storage tanks wheeled up on a truck



Benda, Maker of Masks, Satirizes Humans

THOUGH masks are as old as [illegible] Benda, famous [illegible] New York City, to create [illegible] of the stage is [illegible]

Lights Attract Food for Fish

FACED with the problem of feeding the fish in his private hatchery, Curtis Wolf, of Wisconsin, devised a novel scheme that provides them with natural food in a spectacular way. He festooned strings of electric lights just three inches above the surface of the water, and turns them on after dark. Great swarms of night-flying insects come to flit about the brilliant globes, and to furnish a meal for leaping trout in the water just beneath. Now each night, as soon as the lights are turned on, the fish come to the surface for a royal banquet.

Hearing through Finger Tips

FINGER tips replace ears with the aid of an electro-magnetic vibrator that has been used in successful experiments, according to Prof. K. H. Gault of Northwestern University. By means of this remarkable device, deaf persons are taught to hear through their fingers.

The device transforms sound waves into mechanical vibrations by which they may be recognized. In doing this it amplifies the original strength of the sound 175 times. In four months' time, it is said, a class of twenty-five deaf persons learned to tell the "feel" of about thirty-eight different words.

Science Studies the "Hot Dog"

NOW the familiar hot dog, otherwise known as the frankfurter, is coming in for scientific attention. Its food value—doubted by many, though it has been sufficient to allay hunger pangs of city and sport fans—is to be investigated by the U. S. Department of Agriculture.

Scientists of the Bureau of Animal Industry would like to find out what chemicals are in sausages, how many vitamins they possess, and how much food value there is in various kinds. hot dog included. Little has been done in the past to determine these facts, though sausages of different varieties are said to be an important part of America's diet.

Surgical Tools Carry Lamps

TINY electric light bulbs are mounted on the shafts of the newest surgeon's instruments, invented by Dr. H. Huebler of Berlin. While the surgeon is performing an operation, the lamp directs a tiny circle of light into the wound, and so supplements the room's lighting.

Models Ships He Served On

FOR many years a British naval officer, Alfred Entwistle, of Greenwich England, is now engaged in creating keepsakes of those days a little more ambitious than the general run. He is building a remarkable series of models, accurate to every detail, of all the ships he, a naval or merchant, he has served on or that otherwise played a part in his career.

Repulse, complete even to searchlight

A Whittler Champ

WHITTLING wood is one of the pleasantest ways to while away spare hours, according to Joseph Parsons, of Joliet, Ill. He has a large collection of objects made with his favorite pocketknife, and he thinks he can't do with an innocent piece of wood aren't worth doing." The pieces shown here with a three-masted ship, heart, chain and anchor, all made from one piece of wood. Also, a keyring with two keys, button hook, bottle opener and corkscrew all fashioned from wood.

Airmen Told to Chew Gum

BESIDES his oxygen tank, the aviator who dares high altitudes may carry a pack of chewing gum—if [illegible] recommended to, by the Royal Air Force training school of London, England. During a rapid descent, it is explained, a pilot must swallow repeatedly to equalize air pressure on both sides of his eardrums. Chewing gum aids him to swallow by stimulating the flow of saliva.

Deep-Sea Diving on Land

THIS curious paradox was recently an actual fact at Hazelton, Pa. When its mine was flooded with water, a great coal company in the mountain district engaged a deep-sea diver from New York to go trouble-hunting a thousand feet below ground. Tried for the first time in the history of hard coal mining in the Lehigh region, the experiment was successful. After an hour in the depths, the diver reported that pumps in the shaft, submerged under forty-eight feet of water, had quit working; and the company immediately remedied the trouble by drawing off the excess water.

THE U. S. Public Health Service recommends for baldness a good tonic, massage, and a dandruff antiseptic mixture of alcohol and castor oil. These measures, they say, will help conserve what hair a man still has, though, there is little chance of bringing it back if you are already bald.

French Secretly Developing High-Speed Auto Engine

CAN motors be designed to drive racing cars faster and faster? Or is there a mechanical speed limit beyond which no motor can go?

With twelve cylinders said to be no larger than demi-tasse cups, a strange new motor being tested secretly by a French automobile company in Paris is expected to drive a car at 240 miles an hour. Rated at only seven horsepower the model motor actually develops more than two hundred, it is said, by virtue of its amazing speed. Tiny pistons are geared to travel up and down in the cylinders 250 times a second—a velocity hitherto believed impossible. Special spark plugs and valves feature the new engine.

Earthworms Sing, Says Science

IF YOU don't believe that earthworms have voices and use them—tiptoe into the garden some warm evening, says Dr. Rudolph Reichenbach of the New York State Museum, Albany, in a statement confirming observations of a German scientist, Prof. O. Mangold.

Listening one evening in the garden, Dr. Reichenbach observed "a chorus of almost unbelievably small voices." Aided by a flash light, he caught several worms in the act of "singing." The worms, he thinks, make these noises by dragging their mouth bristles over the edges of their holes in the ground. Mangold, however, believes they "sing" by clicking their mouths open and shut.

Seeks Fortune Raising Frogs

EIGHTEEN thousand frogs to the acre is the ambition of Emil Hendrich (below), of Washington, Mo., who at fifty-seven hopes to attain fame and fortune by frog farming. He has already brought upon a couple of hundred square feet of his back yard, which he sells for prices ranging from $6.75 to $24 a dozen.

The photographer worked fast to "catch" these lively subjects at the right moment

She's Boston's Only Woman Watchmaker

REQUIRING aptitudes, patience and painstaking exactitude, watchmaking would seem to be an occupation peculiarly fitted for women. Miss Bessie M. Austin, only woman watchmaker in Boston, finds real pleasure in the work, and believes more women should go into it. The shop she works in is only five by ten feet.

Miss Austin, in her shop, restoring an ailing watch to good health

One Auto to Every Three Adults in the Country?

RAPIDLY we are becoming a nation on wheels—so the statistics for autos are no longer exact, for the near-rich alone. Every fifth person in the United States has an automobile, this year's license figures show, with a grand total of 22,342,437 passenger and commercial cars registered. Our motor population has increased eleven percent in the last year, despite an unprecedentedly large number of a thousand lives that were taken and to relieve severe and wrapped.

New York state ends the automobile census with its 1,848,000 cars, about half as many as the rest of the world outside the United States. California is a close second, and five other states each have more than a million.

Woman Runs Two Big Garages

WHO says women don't understand machinery? Not at any rate, Mrs. Mabel Hansen, of Evanston, Ill., who owns two of the largest garages in her town. After her husband died, Mrs. Hansen took over the management of a 150-car garage. When she found the one next door that seriously rivaled it, with 115 machines, a serious competitor, she bought that too and continued it with her own. Now she spends her time keeping the company's books and occasionally finds a moment to change a tire herself.

Mrs. Hansen, though she took over the business only after her husband died, is no parlor business woman. She can change a tire on her automobile with the speed and skill of an expert mechanic

Nelson's Ship His Model

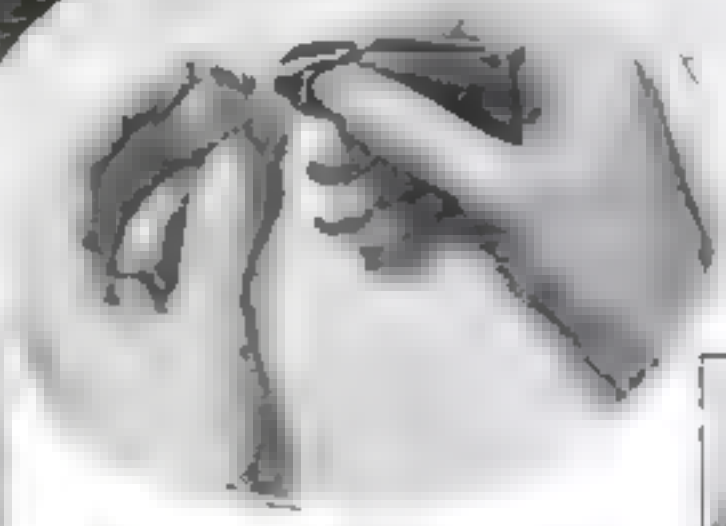
IT TOOK nearly two years of work and study before E. T. Meek, of Chicago, completed this remarkable model of Lord Nelson's flagship, the *Victory*. Details of the deck equipment, rigging, carvings on bow and stern, and other incidentals of construction, are reproduced faithfully—even the exact method of lowering the lifeboats.

It was on board this same flagship that the brilliant career of England's great naval hero came to an end, in the course of an engagement with the French ship *Redoubtable* in the Bay of Trafalgar. Nelson was pacing the decks urging his men on to victory when the ships came together, and the great commander was struck by a musket ball fired from the rigging of the French ship.

Modern Tools *for*

At last a good light for the dressing table says the maker of these new electric lamp brackets that are screwed to the back of the mirror on either side. Two curved arms bring the light around the edge of the mirror to the front

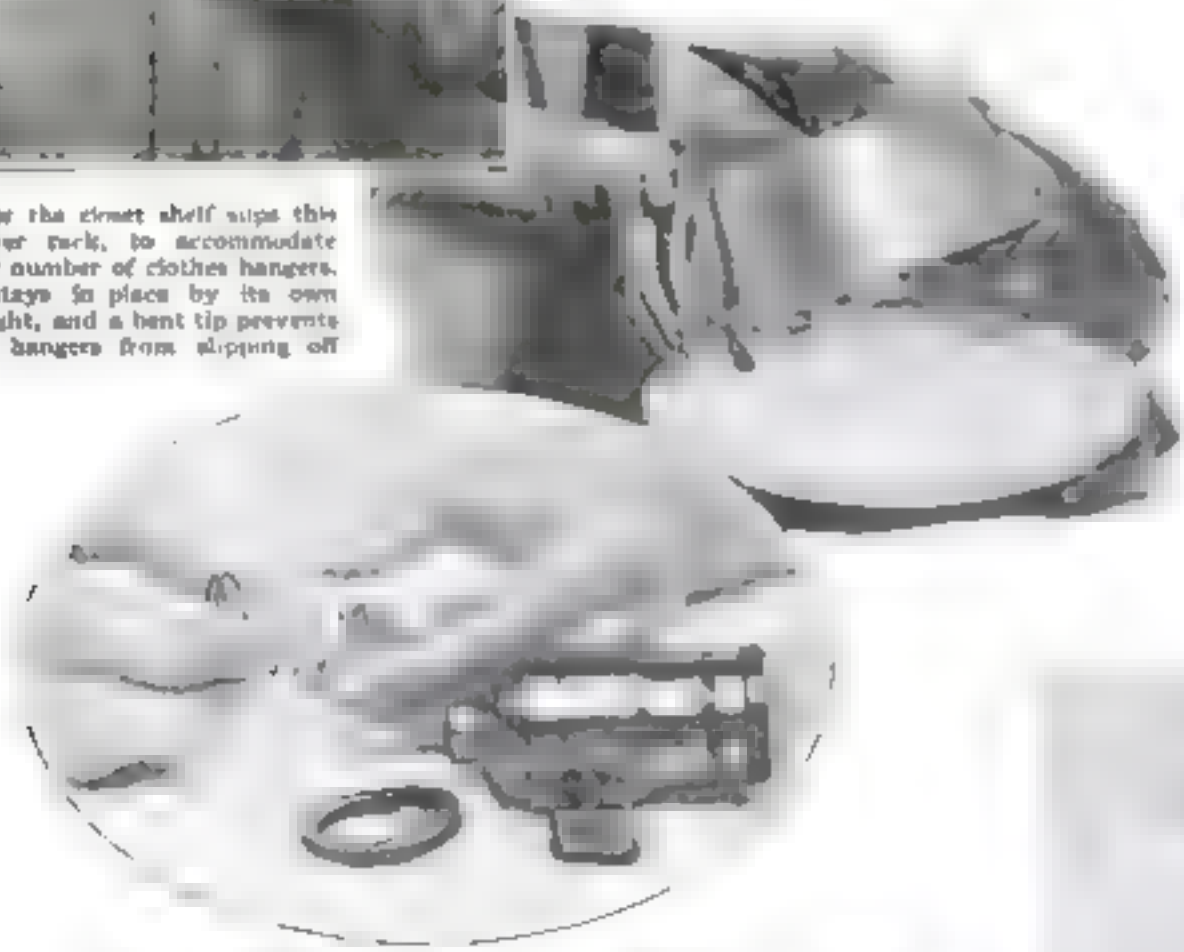
(Below) When a quantity of strawberries is to be hulled, this novel little device saves the house wife's fingers and nails Its tenacious pincerlike jaws make short work of the job Also, when a chicken is prepared for cooking, it removes pin feathers with dexterity



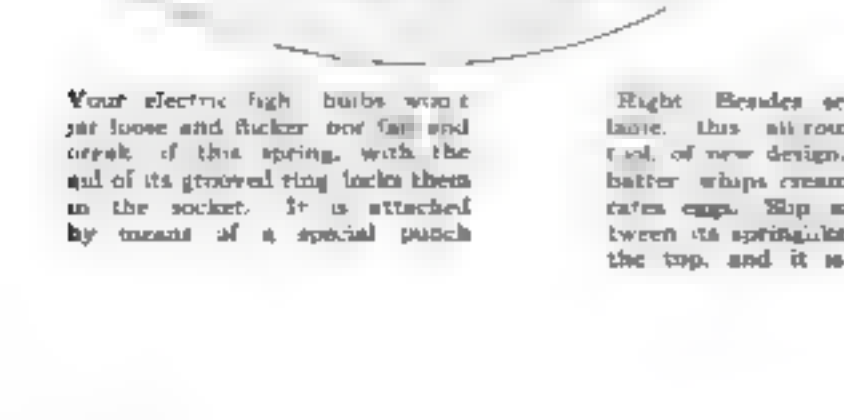
When the steel wool you use to clean pots is worn down to the last shred, this holder will grip it without scratching the utensil A sliding clamp closes the metal fingers that grasp the wool. The device will hold a dishcloth also

Below Angel cake should be allowed to fall out of the pan by its own weight A new pan aids the process by means of three ingenious prongs, which support the cake pan, upside down, above the plate into which the cake is to fall. The prongs are riveted securely on to the pan

Dip this curved glass tube in your milk bottle and out pours the top layer of cream. An automatic syphon does the trick handily and you can be sure the cream isn't "half and half" The tube can be cleaned easily



Over the closet shelf slips this clever rack, to accommodate any number of clothes hangers. It stays in place by its own weight, and a bent tip prevents the hangers from slipping off



Your electric light bulbs won't get loose and flicker nor fail and break if this spring, with the aid of its grooved ring locks them in the socket. It is attached by means of a special punch

Right Besides serving as a table, this all-round kitchen tool, of new design, beats cake batter whips cream, and separates eggs. Slip a marble between its springlike coils, near the top, and it is a strainer!

Today's Homemakers

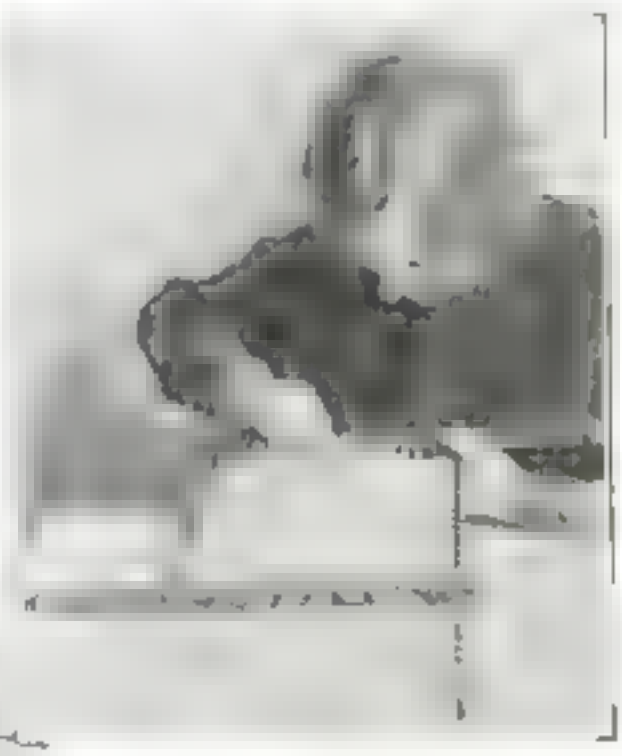
Clotheslines collect dust between wash days, and sometimes soil freshly washed clothes. Above is a new brush to clean the clothesline. Its double handle squeezes a flexible brush of special shape around the line, which is then pulled through it

Below This novel bottle stopper, unlike a cork, won't get dirty break or fall inside the bottle. It is made of rubber and a push on the handle stretches the rubber when the stopper is inserted in the bottle thus insuring a tight fit

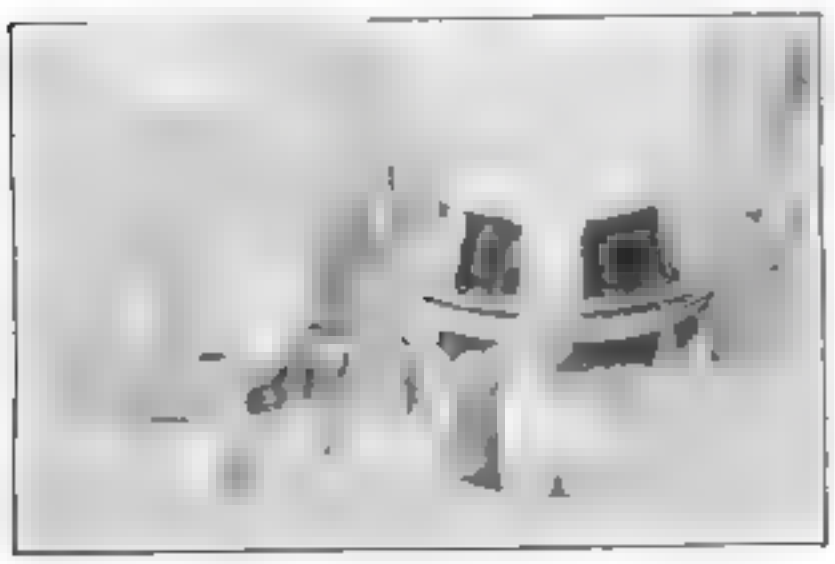
Thin and flexible, a new detachable edge fits on your dustpan to catch all dirt that might be swept beneath making it possible to sweep the dust on the pan at one stroke

Teakettle and double boiler are ingeniously combined in an economical new utensil the inner part of which fits snugly into the mouth of the kettle the cover of which fits either

Below Shaped like clothespins a novel little machine separates peas or beans from their hulls as fast as you insert them! Rubbers of rubber are adjusted to squeeze out the contents of each shell just gently enough to avoid crushing



Many sizes of fancy work can be woven on this loom by a simple adjustment. Notches in the four interlocking wooden sticks which form the sides permit the size to be changed without screws or clamps



A little of everything in this five-piece aluminum cooker left kettle containing roaster bake dish, pudding pan, double boiler or preserving kettle Note that the handle cannot drop clear to the rim of the kettle, which makes it easy and cool to pick up

A new pocket comb designed to clean itself has a sliding cover that is a metal case when the comb is not in use A flick of the hand, and it opens closed, it automatically "sweeps" the teeth clean, ready for use when needed again

Sam Loyd's Page

How Sharp Are Your Wits?

Try These Fascinating Tests to Measure Your Abilities

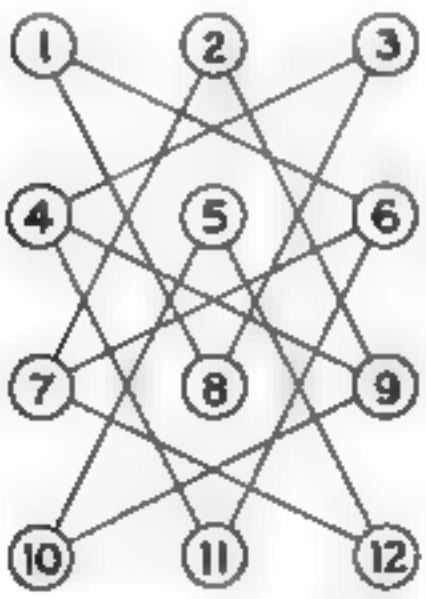
The Nine-Celled Square

INSPECTION of the design above, a square containing nine cells, reveals that at eight points of intersection the number of branches is odd.

The rule for such an analysis is to divide the total number of odd points of intersection by two, to determine the number of continuous lines necessary to construct the figure. So this design will require a minimum of four separate continuous lines, if the retracing or crossing of a line is prohibited.

Let us imagine that the figure is produced by the laying down of four separate wires, of uniform length, all bent into the same shape and not crossing. What will be the common length and shape of those four interlocking wires?

This problem calls for a certain concentration and close inspection. It will test your sense of form and discernment. For your rating turn to page 147.



A Visual Promenade

THIS is a visual pilgrimage, in which your eye must start from cell 1 and follow a certain route along the lines to cell 12, after having made a single call at each of the ten intermediate cells. If you can mentally direct your vision through that labyrinth with reasonable ease, vision and mentality are working in nice coöperation. Time yourself; then find your rating on page 144.

The Circulating Coin

THREE messenger boys in a downtown New York office figured out their personal accounts as follows:

Messenger 43 owed messenger 98 three cents; 98 owed two cents to messenger 74, who owed a like amount to 43.

Well 43 received a tip in the form of one coin which he paid to his creditor on account. This started a good example and by giving it proper circulation, that coin was made to square the accounts of all three. How was it accomplished?

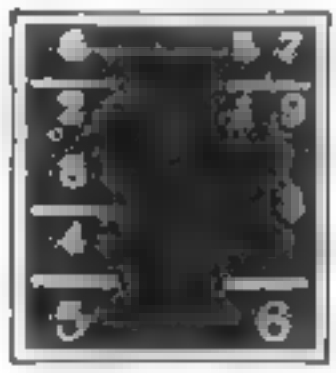
One who has a talent for accountancy will sort out those facts and figures in a few minutes. The correct answer and your rating will be found on page 147.

Mental Scissors Cutting

THIS figure, which in area is three quarters of a rectangle whose length is twice its width, you are required to scissor mentally into four pieces of the same size and shape.

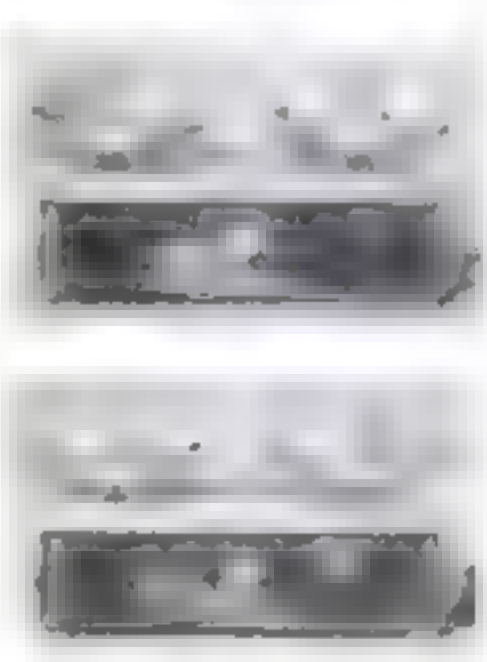
Ability to analyze geometrical forms methodically will be evidenced by your speed in reaching the solution. For your rating, based on the time it takes you, turn to page 147.

SAM LOYD, the world's most famous puzzle man, offers these brain-teasers from month to month in POPULAR SCIENCE MONTHLY in response to requests from hundreds of readers. To use them as real tests of your mental ability, time yourself in solving them and compare your time with the ratings on page 147.



Tricky Digits

HERE we see how the digits, with the even and odd figures grouped separately, by employing vulgar fractions, may be made to sum up to 5 and 6 respectively. Can you discover another method of presenting the two groups, this time without employing top-heavy fractions, to make the two sides add up exactly alike? For the solution of this tricky problem, turn to page 147.



A Joker in the Scales

IN THE upper scales, the bottle weighs 8 ounces. In the lower view that same bottle weighs only 6½ ounces! A merchant who could purchase his goods from the right side of those scales, and make his sales from the opposite side, might get rich quick.

The shifting of the fulcrum point in scales is by no means an impractical species of rascality. The fact that one arm may be longer than the other may be masked as shown in the sketch, and by weighting the short side secretly, the two empty pans may be made to balance evenly. Of course, when weighings are made on such a scales, the off-center leverage comes into action.

Now that we are privy to the doctored scales, can you establish the true weight of that bottle? If you have an aptitude for mathematical inspection, you should arrive at the answer quickly. Time yourself; then turn to page 147.

Are You *a* Throttle Hopper?

Needless "Stepping on It" Strains Every Working Part of Your Car, Says Gus

By MARTIN BUNN

PERCIVAL STEBBINS jammed the throttle down to the floor boards and vigorously thumbed the horn button preparatory to making his usual wild dash up Marley Hill. He waved his hand disdainfully to the driver of a sporty little coupe as he flashed by.

At each curve of the steep and dangerous grade Stebbins snapped his foot off the throttle pedal just in time to latch around the turn without skidding off the road and then down would go the throttle again almost before the big sedan had time to straighten out.

The husky chap at the wheel of the coupe dramatically shook his head.

"That little guy is going to get busted wide open taking chances like that," he muttered to himself. "And like as not when a piece of the landscape hands him a swift left hook, he'll pass out cold—maybe with two or three poor birds to keep him company."

O'Rourke, known to his friends as "Spuds," continued up the hill at a reasonable pace, his huge hands manipulating the fancy steering wheel with considerable skill. Almost at the top he came upon Stebbins parked by the roadside.

"What's the matter, kid, are you down for the count?" he called.

"It looks that way," admitted Stebbins glumly, as he closed the hood. "She was coming up in fine shape, then I heard something snap and the motor began to roar, but the car slowed down."

"Must of got bit below the belt somewheres," suggested Spuds. "Maybe it's a case of bad wind. Them big guys is always like that. I've put a lot of big stiffs to sleep in my time myself, on account of no staying power."

Stebbins ruffled up like a wet hen. "This is a good car. I want you to understand. It's got lots of staying power, only something's gone wrong, that's all."

"I'll say it has," Spuds grinned. "It'll stay right here unless you do something about it. Maybe a dash of water'll put some steam in the old boy again, and a little fanning wouldn't do any harm. Seems kind of warm to me. Got a tow rope? Guess you'll have to give a couple of rounds from here. I'll tow you."

"What with that?" gasped Stebbins.

What Was Wrong with Captain Horne's Car?

IN THE January issue POPULAR SCIENCE MONTHLY published a story detailing the troubles of Captain Horne with his "reconditioned" auto, offering a prize of $25 for the best letter explaining the trouble and telling how to overcome it.

A. L. Mallory, of Lebanon, Kansas, wins the prize. The timing chain on Captain Horne's car was jumping teeth, and many contestants indicated this as the source of trouble. Of these, Mr. Mallory, in the opinion of the judges, offered the most accurate diagnosis of the trouble and the simplest and most effective remedy.

"Why you couldn't budge this boat!"

"You gimme a tow rope and I'll show you that a lightweight can bring home the bacon if he's trained right," Spuds suggested good-humoredly.

Stebbins shrugged his thin shoulders. "I never had any use for a tow rope before," he said.

"GET out your chains, then. Maybe I got something to piece out with." Spuds opened the back compartment of his car and fished out some short lengths of rash cord which he proceeded to tie on the ends of the tire chains. Stebbins was still attempting to tie a knot when Spuds had finished lashing the other end to his rear bumper.

"What are you trying to do up there for?" Spuds demanded. "You can't tow a car by the radiator cap, you'd snap! Tie it on the bumper. Now you keep your foot handy to the brake and watch out you don't go into a clutch with the back of this bus if I have to stop sudden."

Spuds, being an ex-pugilist, knew when to hit hard and when to pull his blows, and consequently he eased his car ahead until the slack was almost out of the rope. Then he stepped on it a bit, and the sharp jerk was sufficient to start the big car moving.

Gus Wesson was leaning against the door of the Model Garage as they drove up, waiting for Joe Clark, his partner to return with some parts for a job he was working on.

"I was wondering how long it would be before you showed up on the end of a tow rope," Gus calmly observed. "Is that so?"

(Continued on page 147)

Seven Useful Kinks *for Your* Car

How to Solder Tank Floats, Build Clothes Compartment, Plug Leaks

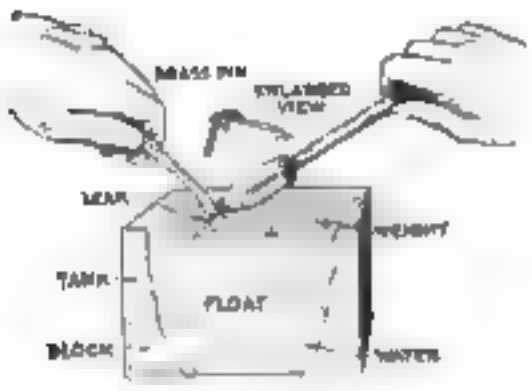


Fig. 1. Solder carburetor or vacuum tank floats in this way to make a tight seal

Ten Dollars for an Idea!

TERRY W. BROWN, of Massillon, O., wins the $10 prize this month for his suggestion of an auto clothes compartment (Fig. 7). Each month POPULAR SCIENCE MONTHLY awards $10 in addition to regular space rates to the reader sending in the best idea for motorists. Other published contributions will be paid for at usual rates.

WHEN you attempt to solder up a leak in a carburetor or vacuum tank float, the heat of the iron causes the air inside the float to expand. The air pressure produced then forces bubbles of air through the hole you are trying to solder, making it very difficult to seal the hole. By immersing the float in a vessel full of water as shown in Fig. 1, this difficulty can be overcome. The water keeps the metal of the tank from heating up to any great extent, except at the point where the soldering iron is applied.

If there is a small hole in the tank instead of a crack at one of the seams, you will find that the soldering is much easier if you cut off an ordinary brass pin and push what remains of the shank through the hole as shown.

If the float is partly filled with gasoline, you can drive it out by supporting it with the hole down and heating the upper side of the float by holding the hot soldering iron close to it, without actually touching.

Protects Garage Padlock

ANYONE who has tried to unlock the padlock on the garage door after a freezing rainstorm, when the whole mechanism of the lock is frozen solid, will appreciate the simple method shown in Fig. 2 for keeping water and snow out of the padlock. An old section of inner tube can be cut in the shape indicated and tacked so that it covers the padlock. Note that the padlock is protected from the bottom by the folded and wired flap.

Ingenious Clothes Compartment

ON LONG motor tours or camping trips it is difficult to keep clothing in presentable condition because of lack of packing space. The space underneath the top of a closed car can be used as shown in Fig. 7. A piece of three-ply veneer is cut so that it fits loosely against the inside of the top. One edge is attached by means of strap hinges as shown. On the underside of the other edge are fastened several large screw eyes. These act as buttons for short pieces of strap attached so that when the board is swung up there will be a space of two or three inches for clothes.

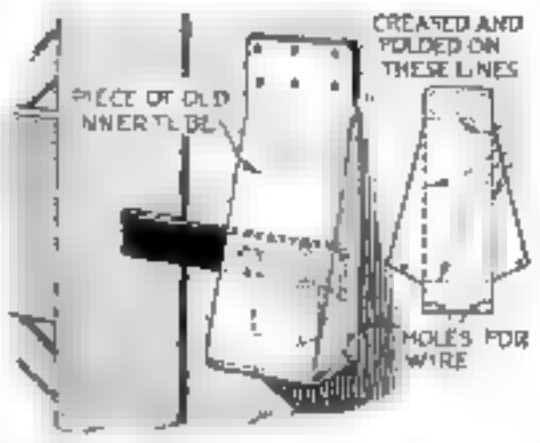


Fig. 2. This padlock cover will keep snow or sleet from jamming the padlock

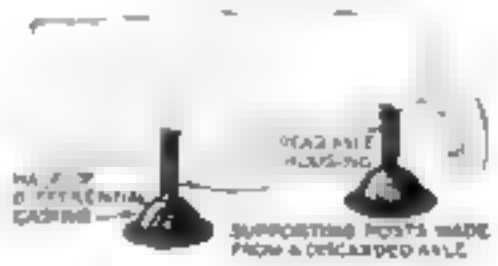


Fig. 3. Old axle supports frame when you have to remove rear axle

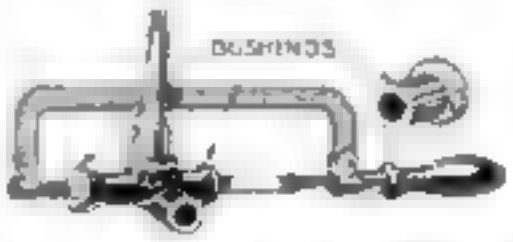


Fig. 4. Above. Hack saw through side wall of your spindle body bushings and they can be driven out easily

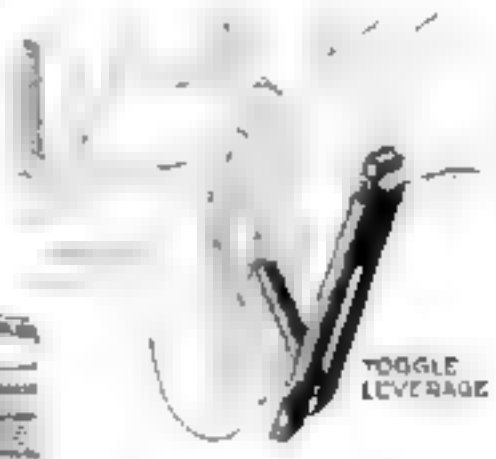


Fig. 5. Homemade wooden wedge that will keep tires off the floor

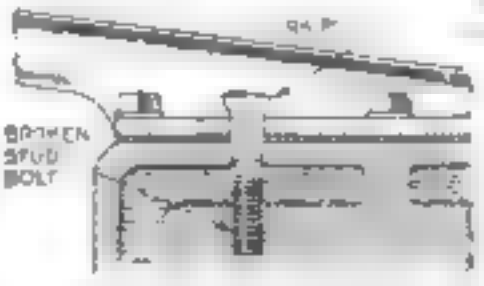


Fig. 6. A few corks in the tool box are handy if you break a bolt

These Jacks Will Save Tires

FIG. 5 will show you how to make up simple tire-saving jacks so that you can get all four wheels off the ground in just a moment. A hole somewhat larger than the hub is cut in a piece of two by four and a one and one-half-inch slot is sawed from one end to meet the hole. In this slot is fitted a short piece measuring slightly less than one and one-half inches wide. It should turn freely on the bolt. As you push the frame toward the car, the tire will be raised off the ground.

Removes Spindle Bushings

DRIVING out spindle body bushings is not so easy unless you have a special tool designed for this particular job. However, sawing through the sides of the bushings will greatly facilitate the work. Unclamp the blade from the hack saw frame and pass the blade through the king-pin hole and then fit it to the frame as shown in Fig. 4.

Save the Running Board

THE common practice on light cars of supporting the chassis of the car on the running boards when the rear axle is taken out is rather risky. The running boards are not designed to support so much weight. The ends of the two halves of a rear axle housing can be cut off to the proper length to form substantial frame supports as shown in Fig. 3.

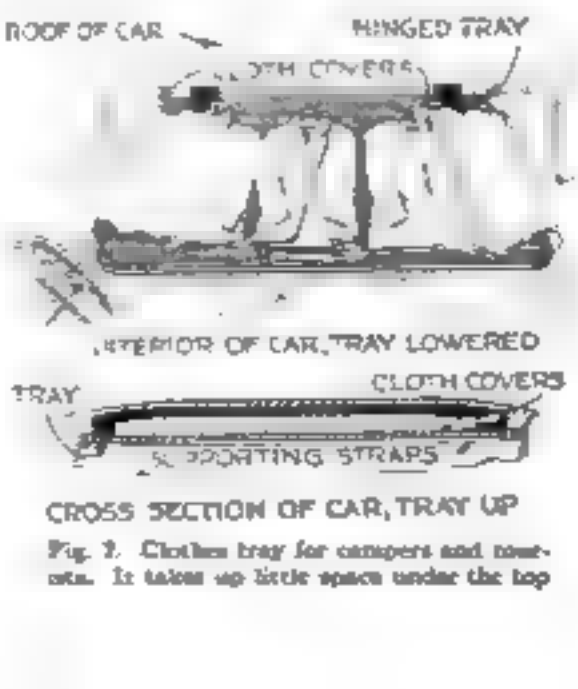


Fig. 7. Clothes tray for campers and tourists. It takes up little space under the top

Cork Will Plug Water Leaks

IF YOU are unlucky enough to break off one of the water manifold bolts so that there is nothing to stop the water in the system from draining away, you can plug the leak with a cork as shown in Fig. 6. A spare cork or two in the tool box may come in handy as a substitute for a petcock in the oil or gas system.

This picture suggests the family resemblance between the telephone and the microphone.

The younger brother of the telephone —

THERE'S reason a-plenty for family resemblance between the telephone and the microphone, familiar symbol of radio.

Each is a gateway of sound. Through the telephone transmitter, your voice starts on its narrow path. So a radio voice first enters the microphone, later to spread far and wide to every tuned-in receiver. Or the orator's voice, in a Public Address System, passes through the microphone to a vast auditorium's remote corners.

But the "speaking likeness" doesn't end there. Back of microphone and telephone is the same engineering skill, the same care in making, the same great factory — the Western Electric telephone works.

It is quite natural, then, that you and countless millions should have come to depend for information and entertainment on the telephone's younger brother, the Western Electric microphone.

Back of your telephone

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

A Bench That Takes No Room

How You Can Make a Removable Woodworking Top for Use on Any Kitchen Table

By E. E. Ericson

LACK of space for a workshop or even for a workbench is proving more and more to be a serious difficulty in the average small home. The modern flat or apartment is planned [illegible] thought of giving the [illegible] chance to express himself [illegible] work.

The apartment dwel[illegible] to use tools does not ne[illegible] despair, however, nor d[illegible] who is deprived of access to a [illegible] workshop or to a workbench. In a most every household there [illegible] kitchen table or other [illegible] these available and if [illegible] bought at a very low [illegible] few minutes' time and [illegible] converted into a sat[illegible] bench for ordinary work, through the use of a simple, detachable bench top like one of those shown in the accompanying illustrations. When the work is completed, the top may [illegible] quickly and the table [illegible] housewife for its custom[illegible]

Such a bench top consists chiefly of a piece of plank 2 by 12 in. and about 8 in. longer than the length of the table top. Southern pine, Douglas fir, cypress or any other soft wood that is not too expensive is satisfactory for this. It is advisable to get the best grade available and to insist that the piece be dry in order to prevent warpage. If it is ordered surfaced on four sides (S4S), its dimensions will be 1⅝ by about 11 in., which is satisfactory.

Fig. 1 (upper view) [illegible]

THIS plank is fastened to the table with two large C-clamps, one at each end, so placed as to be out of the way as much as possible. It is well to screw two cleats across the board on the underside, spaced so as to fit snugly against the ends of the table top. These take much of the strain from the C-clamps when planing or similar work is being done.

For the simplest arrangement, two hand screws will form an inexpensive and satisfactory substitute for a regular [illegible]. One experiment, which is [illegible] in these views on this page [illegible] piece clear of cumbersome attachments and [illegible] to store in a small space when not in use. In addition, the hand screws are of frequent use in clamping together work that has been [illegible].

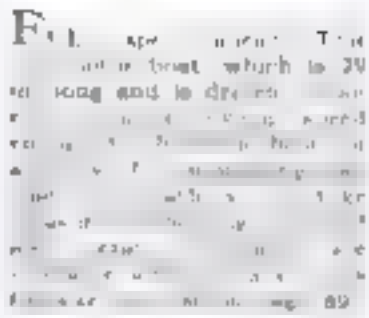
[illegible] shows how the hand screws are [illegible] the top surface of the bench for planing the edges of boards that are not too wide to be supported in this way.

FOR wider boards, the screws are placed so that the inner jaw of the horizontal one comes even with the edge of the bench. Fig. 3 [illegible] used in this way. The hand screws serve much like the ordinary vise. If the boards to be planed are long, the free end must have some means for support, suggestions for providing this will be given later. When attached as illustrated in Fig. 4, the improvised vise serves well for ripping because the saw can be run down past the level of the bench.

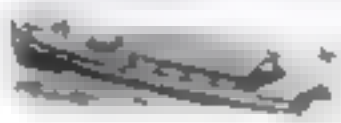
A bench stop made of wood will prove quite satisfactory for this type of bench. Such a stop will also help to keep down the cost to a minimum. It can be made by the common method of sawing a V-shaped cut in one end of a piece of wood and nailing it on the bench at the left-hand end.

A little more (Continued on page 101)

A Boy *Can Build* This Boat



Speedy Toy Motor Cruiser Run by Radio C-Battery Costs Little



By Frederick P. Berman

JUST mention motor boats to a boy and see the broad smile that lights his face. That's true, too, of many men for there is something extraordinarily fascinating about a toy motor boat that will run speedily under its own power.

Of all the shop projects I have tried with boys in my manual training classes, nothing has been as popular as the making of motor boats. Personally I find the construction of a boat entertaining almost as much as it does the boys.

"But it is a pretty hard job for anyone to make a fast, good-looking toy motor boat," you may say.

That depends. Some model motor boats are so elaborate that they call for the utmost skill of an experienced mechanic, but the type of boat to be described in this article is so simple in construction that it has been built repeatedly by boys of thirteen and fourteen years. Little skill in the use of tools is required, and any slight errors in measurements and fitting are not apt to do any particular harm. The very fact that public school boys can build the model so successfully indicates that the boat can be made without difficulty in the average home workshop.

One thing, however, you must have and that is a full-size drawing of the boat. This you can make yourself, if you wish, by following the instructions and enlarging the small drawing on page 92. That is a somewhat tedious and difficult task, and you can save yourself the trouble by sending 50 cents to Popular Science Monthly, 250 Fourth Avenue, New York, for Blueprints Nos. 63 and 64 (see page 89). On these sheets all the parts are shown full size.

The necessary tools are a nail hammer, screw driver, hacksaw or handsaw, drawknife, block plane, bit brace and ⅛ and 1-in. auger bits; ⅛ and 3/16-in. drills for use in the brace or in a hand drill of some sort available, 1-in. wood chisel, 1-in. gouge, fret saw or coping saw and blades, hack saw, soldering iron, small tin snips or old shears, pliers, oilstone, try-square and rule. Hand screws are an aid in gluing up the hull block and, of course, other tools may be used, if at hand. A good pocketknife will accomplish wonders if skilfully used.

The materials required are 3 pcs. clear white pine 1½ by 6½ by 28⅞ in., or a sufficient quantity of pine of any other thickness to glue up into a block 4½ in. thick; a strip of white pine ⅜ by 1 by 24½ in. for the keel; a few small pieces of ⅝ and ⅜ in. thick pine and mahogany (or other hardwood) to make the decks, rails and small fittings; 1 pc. white pine ¾ by 3¾ by 7 in. for the stand; 1 pc. ⅛ in. outside diameter seamless brass tubing 17 in. long; 1 pc. ⅝ in. outside diameter seamless brass tubing 22 in. long; 1 pc. sheet brass of any gage from No. 18 to No. 22, 4 by 4 in.; toy motor of the 2 to 4 volt type; 2 radio C batteries 4½ volt; 2 flashlight lamps; 1 flashlight battery; 6 brass grommets (⅞-in. hole); a ¼ in. dowel stick 2 ft. long; 1 doz. brass screw eyes or screw hooks 1 in. over all and as fine as obtainable; and 2 ft. No. 12 or 14 brass wire for rudder; 1 ft. ⅛ in. square brass rod (for propeller guard); 2 ft. magnet or bell wire for battery connections; small brads, small brass screws and glue.

FOR finishing the boat, very small amounts of shellac, red mahogany wood dye or varnish stain, and paint,

brushing lacquer or enamel will be needed.

The largest item of expense is the motor. The boys in my classes use a small toy motor that costs less than $2. Some of them have kept the whole cost of materials within $6. In the average home workshop it may be possible in some cases to keep the cost even lower, because there are always odds and ends of lumber, paints, wire and the like, on hand, which can be utilized in this kind of work.

The boat is 4½ by 6½ by 28¼ in. The hull is made of three pieces of clear white pine, each 1½ in. thick. Prepare the surfaces to be glued by scratching them with the teeth of a backsaw. The roughness makes a more secure glued joint.

The gluing is a most important part of the construction. If the pieces of wood are not flat so that the surfaces come together perfectly, or if the glue is of poor quality, or if it is not applied properly, there is danger that the joints will open when the inside of the hull is being gouged out. I impress this point upon every boy when he is ready for gluing and show him a spoiled model to emphasize what will happen if the gluing is not properly done.

CASEIN or waterproof glue is preferred by many for this purpose, but I have had uniformly good results with the best quality of cabinet-maker's glue. First clean the gluepot of every trace of old glue; it should be as clean as if one intended to cook food in it. Put in some flake glue, or cake glue which has been broken up into small pieces, cover with cold water and set aside to soak overnight. I gage proportions by filling the gluepot half full with cake glue and then filling the pot entirely with water. To heat the glue for use place water in the outer receptacle or jacket of the gluepot and set over a small flame. In the absence of a regular gluepot, a double boiler may be used, or two cans, a small one for the glue and a larger one for the water.

While the glue is being warmed, close all the windows in the room to keep out drafts and see that the temperature is 72 degrees or more.

Take five hand screws, if you have them, and clamp the three pieces together, just as if they had been glued. Then turn back the spindles one or two turns and lay the hand screws near where you are to do the gluing. This is to avoid any delays and the possibility of the glue becoming chilled.

If you have no hand screws, you may be able to borrow some from a friendly carpenter. If not, you will have to devise some means of clamping the pieces together. You can, for example, make a clamp by cutting from a heavy plank two pieces a little larger than the whole block is to be, and nailing short strips to them in such a way as to form a sort of crate, open at both ends, into which the boards may be slipped when they have been glued together. Have ready a number of wedges that can be driven between the top of the glued-up block and one of the planks, to force the whole together very tightly. If you have a jack you can arrange a device something like an old-fashioned letter press to force the glued boards together. Indeed, very heavy weights would serve, such as a pile of stone paving blocks. In any event you must have some means of applying pressure quickly and easily.

Lay the surfaces to be glued on radiators or some other mild source of heat for about ten minutes before you apply the glue. If possible, get someone to help you so that the glue can be applied and the pieces clamped in position in the least possible time.

Generally I use three clamps along one edge and two on the opposite edge, one between the first and second clamp, and the other between the second and third clamp. Allow the glued pieces to remain clamped at least 24 hours.

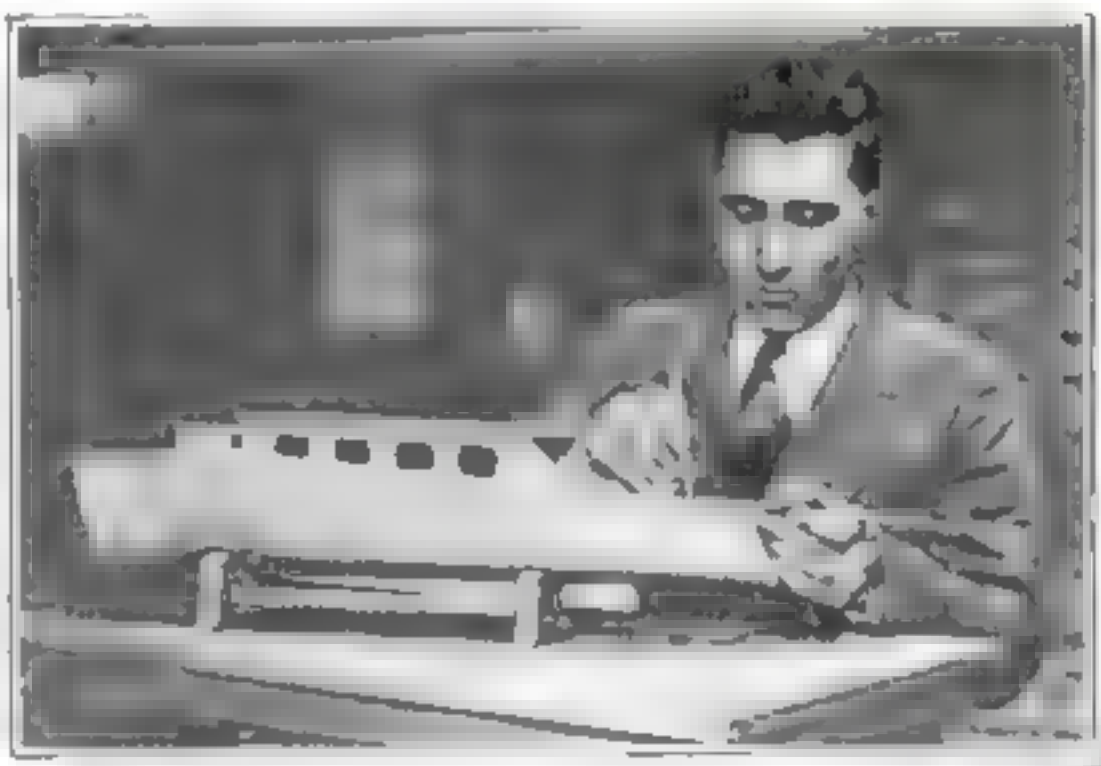
After your block is ready, the first step is to draw a center line on the surface you have picked for the deck, do the same on both ends and the opposite surface. Then draw section lines I, II, III, IV, and V around the block in the positions indicated on the blueprints or by the dimensions on the plan view on page 92. Note also the perspective sketch of the finished deck. These lines are important.

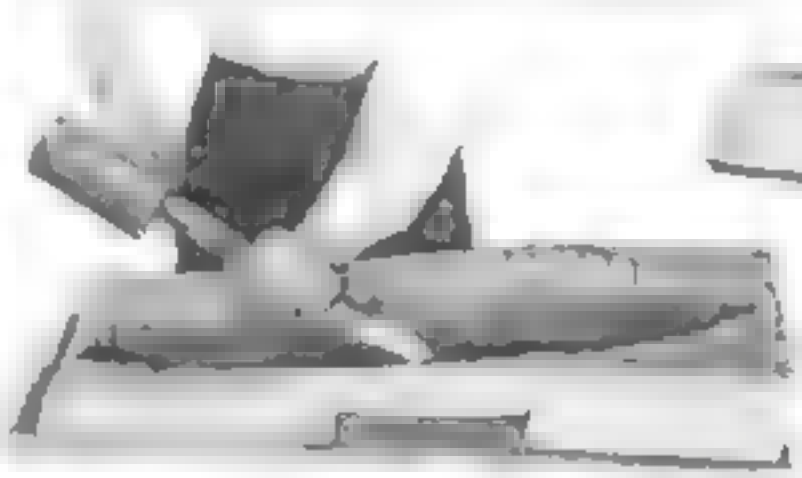
You will now need a series of five cardboard templets to aid in testing the shape of the outside of the hull at the construction lines I, II, III, IV, and V. These templets are shown full size on Blueprint No. 64 and on a reduced scale on page 92.

Transfer the shape of the deck to the upper surface of your block from the blueprints or your own full size working drawing. Do this very carefully. If the curved line at the bow does not show clearly on the wood, bend a steel ruler or a thin stick to the required curve and mark it distinctly.

Next lay out the lines on the edges of the block as shown on page 92. These also can be transferred directly from the blueprint.

A great deal of time and hard work can be saved by taking the block at this stage to a woodworking mill and having it sawed on a band saw. My boys have this done at a near-by (Continued on page 92)





The cabin is not attached to the hull; it can be lifted off bodily to allow the power plant to be inspected and the batteries renewed

How to use a chisel in [illegible] the [illegible]

How to *Refinish* Your Floors

Three Ways to Remove Old Varnish · Bleaching Stains with Oxalic Acid—Sandpapering—Applying Wood Filler

By Ralph G. Waring

FLOORS are one of the greatest sources of household care. They are scuffed and scraped like no other woodwork and the moment they are neglected, their scratched and dingy appearance becomes an eyesore. To keep them in condition is not particularly difficult, but you must know just what to do and how to apply new preservative varnish or floor finishes.

If your floor is of good material, comb grain pine, slash grain or quartered oak, maple, beech or birch, but has been more or less neglected, the most economical procedure is to engage a contractor who has a motor driven floor sanding machine. This work should be done promptly when the painting, papering or house cleaning has been completed, since in spite of all care in designing the machines, dust is apt to find its way all over the house. This should not discourage you, however, since the temporary inconvenience of moving out of the rooms is more than offset by the sight of freshly surfaced floors. In most cases out of ten, this treatment will produce what is practically a new floor.

Floor with a burlap pad

The machine operator generally will cut across the room with a paper as coarse as No. 3 to get below the old finish and to true up the floor. Then the paper is changed to No. 1, run lengthwise of the floor to cut out the scratches from the first operation, and changed again to No. 0 or No. 00, which is used to produce a really fine machine polish on the bare wood.

The owner should insist that the mopboard or baseboard moldings be taken up before the sanding is done and that all margins left by the large machine be carefully removed by a small hand sander or hand scraped and sanded true to meet the main surface.

Any iron spots, ink spots or other stains may be removed by using a solution of oxalic acid crystals, one ounce to a quart of hot water, applied to the spot with a clean scrubbing brush and allowed to dry. If the spot is not entirely bleached, treat it again after sanding lightly. When satisfactory, neutralize the acid spot by sponging with a tablespoonful of baking soda dissolved in a pint of hot water. To neglect this last treatment will often cause a pink spot to appear on the floor. When the wood is dry, sand it smooth.

If it is not expedient to machine surface a floor for financial or other reasons, two methods are available, one using a strong caustic solution, the other a varnish remover.

IN THE first instance, about two pounds of washing soda, soap powder or other cleansing preparation are dissolved in a ten-quart pail of hot water. Before starting to work, the hands should be rubbed with vaseline or covered with rubber gloves or old kid gloves previously dipped in warm but not hot paraffin to render them somewhat waterproof. Use a stubby old corn broom to apply the caustic evenly to a strip ten boards wide, clear across the room, starting at the farthest point from the exit.

Use the broom and No. 3 steel wool to loosen the old finish until softened clear to the wood. Before it has had time to dry, the old finish should be mopped up with plenty of clear water. Then wipe as dry as possible with a wrung-out mop in order to avoid getting an undue amount of water in the joints of the flooring. This process should be continued until the entire floor (Continued on page 100)

Old kid gloves dipped into warm paraffin will protect the hands from caustics

The old varnish may be softened with caustic solution applied with a broom

A weighted floor brush faced with No. 1 sandpaper is used to smooth the wood

Graceful Gate-Leg Tables

Two Noteworthy Pieces of Furniture That You Can Construct Easily

One Is Designed After Triangular Model of an Early Period

By Herman Hjorth

Instructor, Architectural Laboratory
Saunders Trades School, Yonkers, N. Y.

THE gate-leg table is peculiarly well fitted to the modern home. It can be folded so as to take up a minimum of space, and extended quickly and with scarcely no effort when a larger table is needed. As the principles involved in its construction are simple and do not call for great manual skill, the making of gate-leg tables should prove of interest to the home cabinetmaker.

One of the oldest types of tables, the gate-leg table dates back to about 1675 in the period known as the Jacobean. During the latter part of that period, after the death of Cromwell and the restoration of the monarchy under Charles II, furniture was made lighter and more graceful in style, and several new forms, such as the gate-leg table, made their appearance. During succeeding periods the gate-leg table never lost its popularity. Today it is made in a great many forms, and is used for a multitude of home furnishing purposes.

[illegible] of simpler dimensions

Of the two models illustrated, that in Figs. 1, 4 and 5 is the simpler. It consists of four legs, framed together as shown, two gates or swinging legs, and a top of three boards.

FIRST cut the four legs and rails and join them as in Fig. 5. If it is desired to put a drawer in each end of the table, two narrow rails, instead of one wide one, are framed between the legs at each end. The rails may be joined to the legs by means of mortise and tenon joints or doweled butt joints.

The shaped feet are sawed out on the hand saw or with a coping saw and are smoothed. The four legs are joined to them by means of dowels. The head showing at each of these joints is simply a thin board through which a hole for the dowel has been bored.

Each gate consists of a tapered leg to which a rail, 3½ in. wide and 10 in. long, is joined. This rail is hinged in turn to a similar rail 14½ in. long, which is screwed and glued to the rail joined to the main legs (see framing details, Fig. 5). The cabinetmakers of old cut the ends of these rails so as to form a hinged joint, called a finger joint or a knuckle joint, but a good deal of skill is required to make such a joint. It is recommended to hinge the rails with a piano (continuous) hinge.

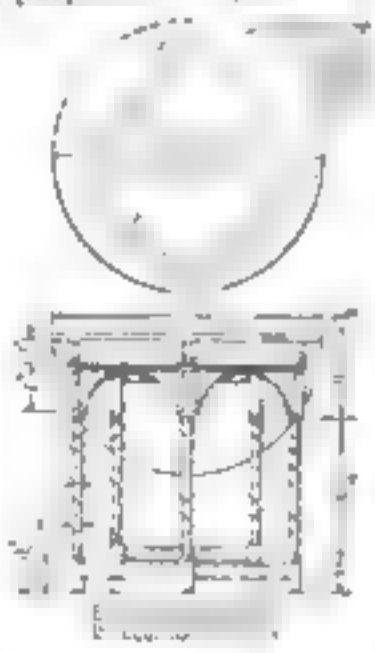


Fig. 1. Highly decorative table of a very early type

The upper ends of the swinging legs are notched (Fig. 4) to fit over the rails when the table is folded and to bring them flush with the other legs. Before the top is fastened, the gates should be adjusted, so that they are level with the top of the frame both in the closed and open positions.

The top consists of one piece 8 in. wide, which is screwed firmly to the frame and two pieces (the leaves), each 12 in. wide. The three pieces are joined by means of butt hinges, screwed to the underside. It is a good plan to glue a small piece of wood to the underside of each leaf to act as a stop for the gates.

This table is suitable for a breakfast table or a card table. The choice of lumber and finish depends upon the purpose for which it is to be used, as well as the furniture which it has to match.

Figures 2 and 3 represent one of the earliest types of gate-leg tables. The frame consists essentially of three legs joined as shown in the shape of a triangle. The two rear legs are squared to 2¼ by 1½ in., after which one of the 1½ in. edges is beveled to 45 deg. as shown. The two upper front rails are 9 in. wide and 10 in. long. They, as well as the lower front rails, are joined flush with the legs by means of dowels. The narrow, square molding is glued on afterwards.

The gate is joined in between the two rear rails by means of a pivot joint (see the detail drawing, Fig. 3). The square parts of the leg having the pivot joints should be made a little longer to allow for cutting and trimming. A hole, about ¼ in. deep, should be bored in each end of this leg before it is cut, so as to make sure that the sides of the leg will be flush after it is cut and the pivot inserted. The two short pieces, 2¼ and 3½ inches, are framed between top and bottom rails.

THE other leg of the gate (the one that swings out) is notched top and bottom to fit into similar notches cut into the rails. The gate should be glued together separately. It must be inserted in its place at the same time the top is glued together.

The front of the legs is decorated with geometrically shaped pieces of wood glued on. The front rails are ornamented by line carving and a series of notches carved below the square molding.

The top consists of two semicircular pieces hinged together. One of these is screwed to the frame of the table. The legs may be turned as shown or left plain. The turning. (Continued on page 104)

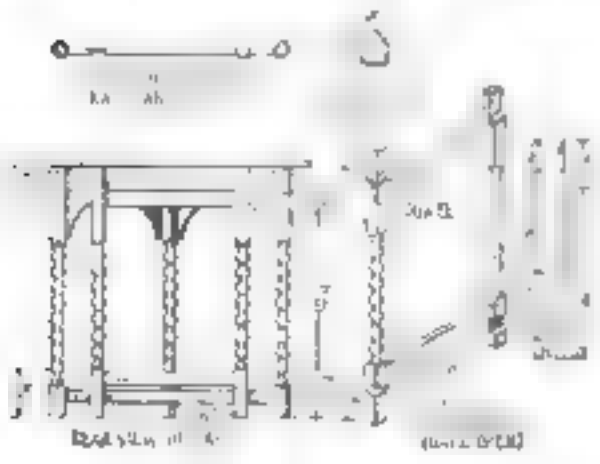


Fig. 3. How the table appears from the rear and details of the legs and gate

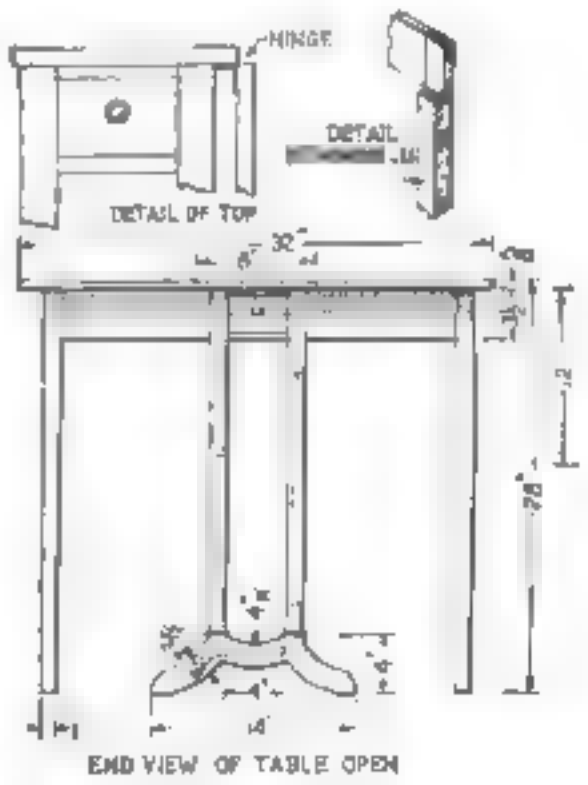


Fig. 4. Design suitable for breakfast or card table. Note details of top and gate legs

Bob Builds a Loudspeaker

He Has Few Tools and No Experience, but Turns Out a Neat and Mellow-Toned Instrument

By CHELSEA FRASER

WHEN I praised Bob's new five-tube radio receiver he was pleased but he frowned as he looked at the loudspeaker. It was of the horn type and, judging from the style, must have lain on the radio dealer's shelf for two years or more.

"What do you think of that atrocity?" Bob growled. "I say such things look better on top of the roof, don't you?"

"Why, it sounds pretty well," I laughed. "Of course, a cabinet speaker might look better."

"That's true, but I can hardly look at this apparent for a year or more," lamented Bob. "We want a cabinet speaker, but I don't see how we can afford the price right now."

"Why not make one yourself?" I asked.

Bob was eager to try his hand at it, particularly when I offered to lend him the working drawings of one I had made for $5.10.

He bought a speaker unit like that in my cabinet and then set to work making the cabinet itself, which is shown in the accompanying illustrations. For this he found some half-inch gumwood boards. Of course, any other good, solid wood might have been used.

WHEN he had the ends and back done he nailed the three parts together, tried to see if they had been assembled squarely, then made the base and screwed the frame to it so that it could be removed easily if that should become necessary.

At work on the throat section of the amplifying chamber. This was of ⅝-in. thick spruce

The throat section of the amplifying chamber was next made. Bob used ⅝-in. spruce for this and other parts of the interior, although he could have employed pine or basswood had it been more convenient to get.

While the small end of the throat was square, the large end was formed on a long angle, as shown in the drawings. Before nailing the last side in, he fitted a block (K) into the cavity, gluing it in place. When the glue was dry, he dressed down the block on top and added the last piece of the throat section, completely enclosing it. Next he bored a hole through the block to take the neck of the unit.

He rounded one end of piece G and molded it to the shortest section of the throat, the larger end screwing the forward end to the cabinet. Then he screwed in piece F and glued the two pieces H to fill in above and below the mouth of the neck section. Pieces I and J were fastened at the forward right hand end of the cabinet. The faces of the pieces F, G, and I were covered with felt to reduce the excessive volume of the wood.

Bob made the top and bottom panels alike except that four feet (L) were attached under the corners of the base. Two stop strips for supporting the grille were nailed in place, one to the top and the other to the base.

Most manufactured grilles are made of plywood and are fretted out with a scroll saw. As Bob had neither veneer nor scroll saw, he decided to try the stunt of using a firm, heavy grade of cardboard and do the cutting with such tools as he had.

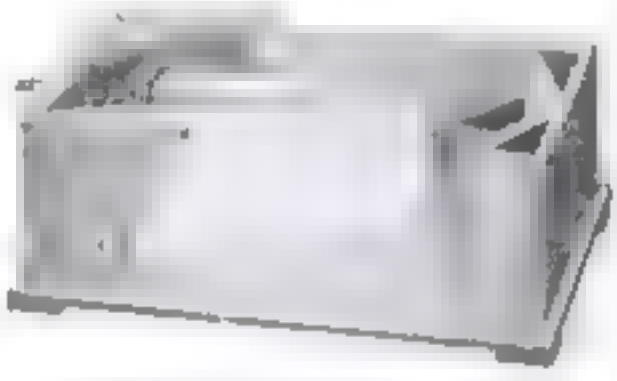
After the cardboard had been cut to the proper size—41½ by 10 in.—to fill in the open front of the cabinet framework, he took pencil, compass and straightedge and laid out his design. To do the cutting, he laid the cardboard upon a piece of board and struck a 1-in. gouge upon all the curves, connecting the arcs with chisel and knife. This gave a surprisingly clean-cut, smooth-flowing grille work.

BOB then stained the grille to match the color he wanted the cabinet to be. When the stain was dry, he gave the cardboard two coats of shellac on both sides. Next he glued a piece of figured silk to the back of the grille.

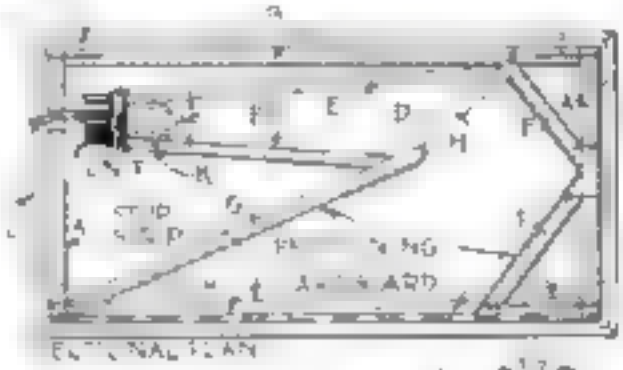
Now he bored a ¾-in. hole through the back of the cabinet, so the unit cord could pass outside, and fastened down the top with brads, which he set and filled with sawdust and glue. He proceeded to give the entire woodwork a good sanding. All rubbing was done in a direction parallel to the grain of the wood.

After applying a coat of penetrating wood stain, he let it dry and then gave the cabinet two coats of shellac. He lightly sanded down the last coat of shellac with No. 000 sandpaper and applied two coats of furniture wax, which he rubbed to a soft luster.

How the loudspeaker looked when finished



A cutaway view of the loudspeaker to show the simple arrangement of sound passages

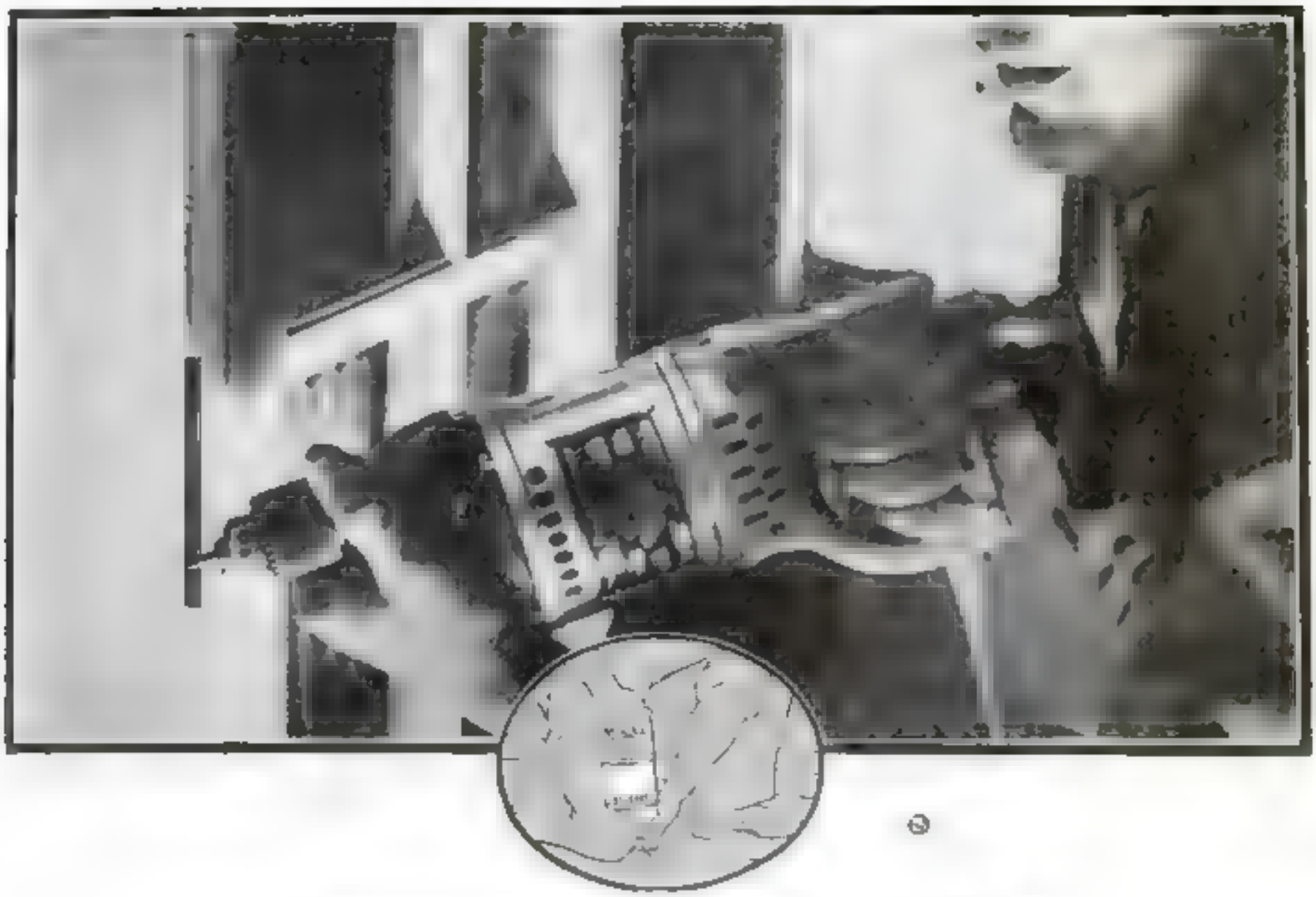


A plan view showing how the parts are placed and details illustrating the throat section and grille

Bill of Materials for a Cabinet Loudspeaker

The finished size of the pieces are as follows, all dimensions being in inches:

Part	Pieces	T.	W.	L.
A			8½	16
B	1		6½	8
C				
D				
E	1			
F				
G				
H				
I	1			
J				
K				
L	4			



This portable electric drill is a beautiful tool to handle—and to own

The uses for the new Millers Falls Electric Drill are almost unlimited. It is designed for rough work and fine work. Its speed and precision are not daunted by any building material, metal, tile, or wood.

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Specifications: Portable Electric Drill No. 414

MOTOR · Universal · operates on D. C. or on A. C. up to 60 cycles · SPEED, No load 1800 R. P. M. 1.2 Amps · CAPACITY, 0-¼ in. in steel, 0-⅝ in. in cast iron, 0-¾ in. in wood · Furnished for 110 or 220 volts · Jacobs heavy duty chuck · Heat treated alloy steel gears · Ball thrust bearing on spindle · Armature mounted on high grade ball bearings · Automatic switch mounted in handle · Armored attachment plug · Aluminum housing efficiently ventilated · Pig-tail brushes (not usually found in drills of this size), easily replaced from outside without taking tool apart · Grease lubrication throughout · 8 feet best quality rubber covered cord furnished · Spindle offset for close boring—⅝ in. from outside of housing · Weight 5½ lbs. net · Overall length 12 in. · Packed one in a heavy corrugated box · PRICE · 110 Volts, $30.00.

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MILLERS FALLS TOOLS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Our Viking Ship Takes Shape

If You Haven't Started the New Model, Begin Now

By CAPTAIN E. ARMITAGE MCCANN

Fitting the ribs in place

"From the ship sick restfulness"
—BOB EMEL

READERS who have followed the instructions given last month for making the hull of a Viking ship model will have already realized that it is indeed a swift craft we are building. This will be even more evident when we get the gunwales on, which we shall now proceed to do.

Those who missed the first [illegible] can catch up without any difficulty by sending for POPULAR SCIENCE [illegible] Blueprints No. 61 and 62, which contain full size drawings (see page 80).

We are building a hull [illegible] as might have been given by a Norse [illegible] is one of the ships. She would [illegible] fast and seaworthy, therefore [illegible] shape. She would also have been [illegible] and gilded quite elaborately [illegible] why, without departing from [illegible] we may make a picturesque model.

THE gunwales are cut from two pieces of white pine by ¼ by ½ in. Before cutting the strips to shape, bend them around the hull on the outside holding them in position with small metal clamps or spring clothespins, as shown in one of the photographs. With a sharp pencil mark the top edge of the hull on them. Draw a line about ¼ in. below this. This one may well be rather close to the previous one mentioned as it does not show as dotted in part on the drawing on page 80.

How the sheer or curve of the hull is transferred to the gunwale stock and how delicate parts are pinned together with the aid of pliers

Shave the gunwales to this line, lay them along the hull again and cut the ends to a sharp bevel so that they fit snugly against the uprights. Mark the top edges but do not cut them. Glue along the upper edge of the hull and the lower edges of the gunwales, clamp them in place, and nail to hull, stem and stern.

It will probably be found that they will fit more snugly at the ends if their lower edges are tapered a bit thinner at the ends. Put a small piece of soft wood vertically over the extreme ends, under the clamps, to get a very tight fit without splitting them. Nail them to the hull in about six places along their length. This is best done with ¾ in. long bank pins; these are obtainable at a stationery shop and are very useful in all model making, because they are finer than any nails. Holes should always be drilled to start them. This may be done with a fine twist drill, such as jewelers use, or with the smallest size of steel crochet needle with its hook filed off to a round point. The latter is not easily broken.

Carefully remove the end clamps and nail those parts to the uprights [illegible]. Bathead nails are best here, but pins will do. Where the protruding heads of the pins are likely to project it is a good idea to rub them flat on a file before using. Any pin points that project through the hull should be snipped off and clinched, by holding some such thing as the flat head of a nail set to the point and tapping the pinhead.

After the gunwales have been glued and clamped to the hull, the joint is made doubly secure with ¾ in. long bank pins

DO NOT bore the holes for the oars yet.

The top edges of the gunwales can now be shaved down to their marks. It very rarely, however, that [illegible] are of the same height. This is ascertainable by placing the model [illegible] upright (perhaps by [illegible] ked in the vise) and stretching a long narrow straightedge across the bulwarks.

[illegible] quite the correct construction of the gunwales. In the real [illegible] planking came right to the top edge and on it were two thicker strakes, one to carry the beam ends and the other the oar ports, but the method suggested here gives us about the same effect and is easier.

It will be noted that this ship has a great sheer by which is meant that it is low amidships and high at the ends. Ships with a big sheer are the driest when the waves are high. These ships are the first known that had to combat really stormy weather because their predecessors of the Mediterranean never encountered anything like the heavy weather of the northern oceans and always ran for port when the weather became threatening.

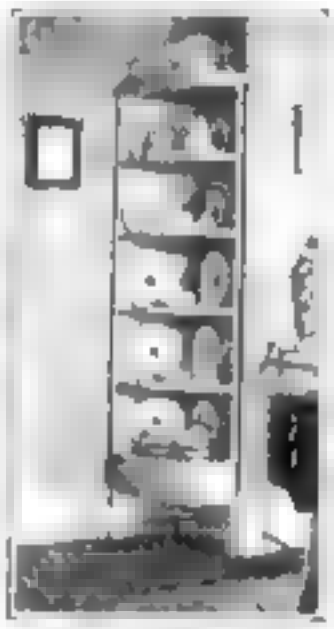
The story of how the Norsemen learned to use this sheer will probably interest those making the model. It is related that the devil taught a shipbuilder that extra seaworthiness could be obtained by the big sheer, but stipulated that he should have every seventh ship that was built. The ship owner prospered, but forgot to keep count, with the result that his children and (Continued on page 96)

Corner Cabinet for Breakfast Room

By Harold F Strand

A CORNER cabinet to display one's favorite set of dishes is a very useful addition for that ever-popular nook, the breakfast room. The cabinet illustrated is attractive, takes up little room, and also has a convenient drawer for silver. The material is kiln-dried whitewood.

The two sides are first prepared. Both are 6 ft. ¾ in. in length, one is 14 in. wide, the other, 14½ in. The surface is smoothed with plane, scraper, and sandpaper. Lines are squared across both pieces, as indicated in the accompanying drawing, and rows of holes ¼ in. in diameter are bored at the intersections for 1¼ in. No. 10 flathead screws. These holes are carefully countersunk so that the screws will go in flush. The other holes are for the screws used to hold the shelves in place.

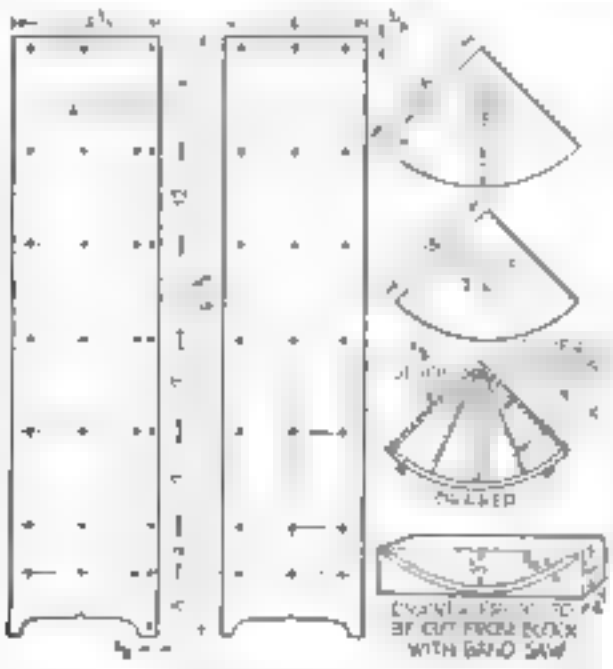


This charming piece requires little space

Seven shelves are required, one of which goes at the extreme top, flush with the edges, its front edge is concealed later by the corner molding. On this shelf or filling piece, is placed the top, which projects equally about ⅝ in.—beyond front and sides.

When the case has been screwed together, a molding about ½ by ⅝ in. is bent around against the piece immediately under the top. If the curve cannot be obtained without breaking the stock, make a series of saw cuts about ⅛ in. apart halfway through the molding from the back and

(Continued on page 100)



How the two side pieces, the seven shelves, the top and the curved drawer are shaped

Hints on Using Lathe Tools

Grinding and Setting Them to Do Plain Turning

By ALBERT A. DOWD

"SAY, Harvey," remarked Bill Simpkins incidentally to Smith, the young machinist, "I hear Tom is going to quit the foreman's job after awhile and go to raising fruit and chickens out on his farm. Did you hear anything about it?"

"No, I didn't," Harvey replied in surprise. "I thought Tom was a fixture. He's been here over thirty years."

Harvey kept the matter in mind and when he saw Grimes, the efficiency engineer, a little later, ventured the daring question he had been revolving in his mind. "Do you think I would stand any show of getting Tom's job when he gets through, Mr. Grimes?"

"Do you think you could handle it, Harvey?" countered the amused engineer with a smile.

"Well, I think I could make a good bluff at it anyway, and I believe I could do as well as any other man on the job. What would you say?"

"To tell you the truth, Harvey, you have not as yet the necessary experience to handle the work and the men. You have the right spirit and the makings of a fine mechanic in you. What you must do is to keep on studying. Learn all you can about shop methods—about tools and machines. Then you may be able in time to handle the job of assistant foreman and I'd surely be pleased to recommend you for promotion."

"ALL right, I'll do it, Mr. Grimes, and thank you very much," responded Harvey, although he could not conceal the disappointment in his tone.

That evening Harvey called on Mr. Grimes at his home for one of their frequent talks about shop work.

"What I want to learn now," Harvey said when they were comfortably settled, "is more about turning tools—how to get better production."

"To work properly," the engineer began, "turning tools should separate the chip from the work with the least possible resistance and without any chance of chatter. If you will remember, Harvey, that the way you hold a tool is almost, if not fully, as important as the way you grind it, you will have taken one step in the right direction.

Courtesy Engineer

Harvey stopped work to ask Mr. Grimes, the efficiency engineer, if there was any chance for him to be promoted to foreman

"LOOK at this sketch (Fig. 1). The tool A is the ordinary diamond point variety held in a tool post B and working on a bar of steel C. The overhang D is very important, as the tool is unsupported for all that distance. As you start cutting, the tool springs in the direction of the arrow and takes a position as shown by the dotted lines. This is certain, of course, to cause a bad case of chattering."

"Well, I would never set a tool with an overhang like that," Harvey said.

"I know it, Harvey, but suppose you were making a roughing cut as in this case (Fig. 2). You would use a diamond point tool set about as shown, wouldn't you?"

"Yes, I suppose I would," answered Harvey. "Wouldn't you do the same?"

"No. I shouldn't use that kind of a tool at all, unless for a very light cut. I would grind a tool as shown here (A in Fig. 3), keeping the face angle fifteen or twenty degrees and the clearance only about five degrees. I would not grind it away as shown by the dotted line B, neither would I use a face angle of thirty degrees as at C. With a long face angle you would have to use a much finer feed because the width of the chip would be greater, as you can easily see in the sketch."

(*Continued on page 112*)

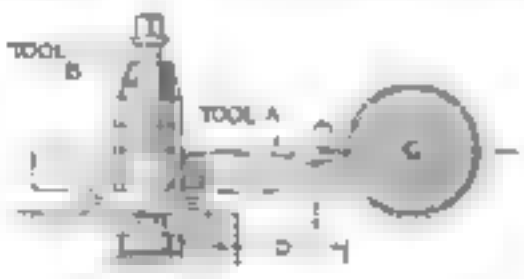


Fig. 1. Tool mounted with so much overhang as to cause bad chattering

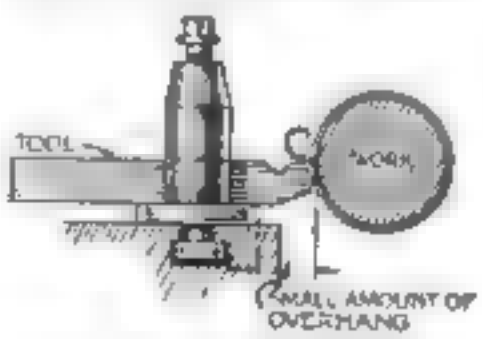


Fig. 2. The same diamond point tool correctly set with little overhang

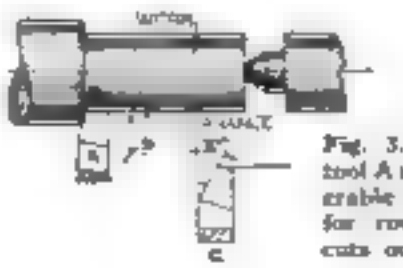


Fig. 3. The tool A is preferable to C for roughing cuts on steel

Fig. 4. Round nose tool for iron (A), a better form (B), and tool for both facing and turning cuts

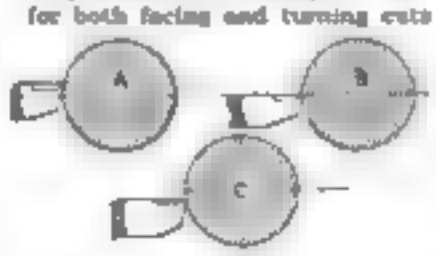


Fig. 5. A tool set as at A obviously would dig into the work the right position is below center

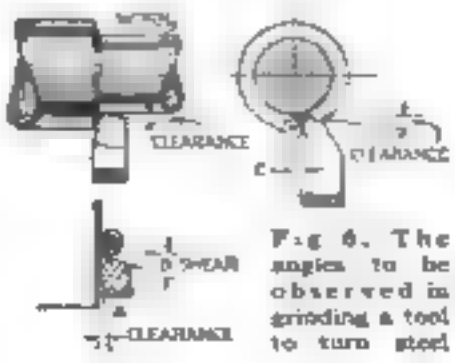


Fig. 6. The angles to be observed in grinding a tool to turn steel

Many time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, on pages 108 to 117.

Few Tools Are Needed to Build This

Attractive Garden Seat

By Kenneth R. LaVoy

PLACED correctly near the flower garden or in a shady spot on the lawn a garden bench looks decorative and is especially inviting and restful after a tilt with weeds or lawn mower. The writer recently built one that he thinks will be deemed attractive, and submits it herewith to his fellow workshop enthusiasts.

The simplicity of construction brings the bench within the ability of the worker with a limited number of tools. It can be built by using only the following: cross cut and rip saws, smoothing, jack or jointer plane, hammer and screw driver, ¼-in. chisel and ½ to 1-in. chisel, keyhole or coping saw.

White pine or cypress is a good wood to use. Two thicknesses are sufficient: ¾-in. stock for the sides, seat and back pieces, and ⅜-in. stock for the splats in the back. If possible get stock of sufficient width to avoid gluing pieces together, which is rather difficult unless one has a pair of furniture clamps.

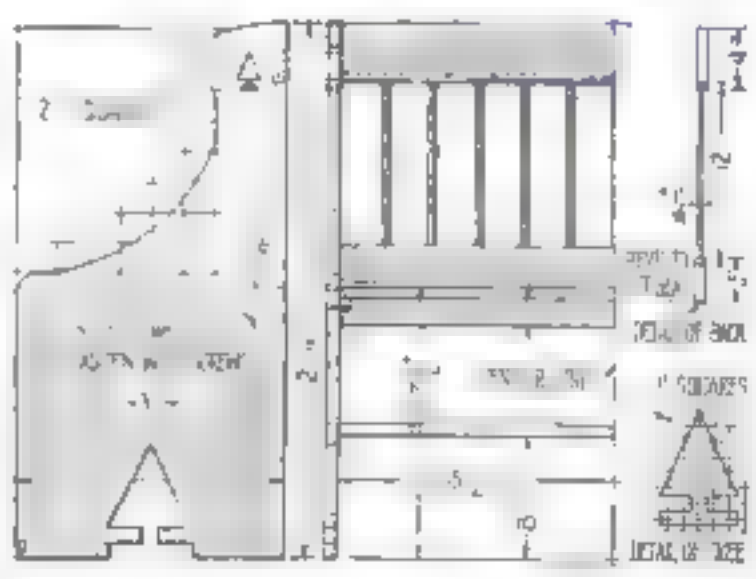
Saw and plane the sides to the required dimensions and lay out the curves by means of squares drawn lightly on the wood. If a band saw is not available, the curves can be cut with the use of saw and chisel. When the chisel is to be used, cut as close to the curve as possible with the cross cut and rip saw, then make a series of saw kerfs at right angles to the line of the curve about 1 in. apart. By watching the grain of the wood the curve then can be cut out with chisel and mallet.

Lay out the shape of the trees and cut them out carefully. Use scrap stock for the cleats and fasten them on with screws.

The back follows in order of difficulty. The ½-in. deep slant or groove to hold the splats can be planed out with a universal plane, but it can also be done satisfactorily with a ¼-in. chisel. The splats are 3 in. wide and should be beveled about ¼ in. on each front edge.

Next get out the seat, front rail and lower stretcher.

In assembling, nail the seat in place first. In driving the nails do not drive them straight in, but slant them, as they will not hold (Continued on page 86)



The end view and half the front view of the garden seat, and details of the back and the large tree design

Outdoor Plant Stands Are Easy to Build

BOXES filled with growing plants and vines are picturesque additions to the home grounds. Many types of stands may be made for this purpose and three especially simple ones are illustrated.

Cypress is one of the best woods for plant stand boxes because it is so little subject to decay. It may be stained and then finished with spar varnish or with

Three types of plant stands for the garden

shellac. If the wood is not free of defects however it is best to [illegible] with [illegible] and apply [illegible] coats of paint.

One [illegible] illustrated supports an old tub, which has been painted dark green. Cheese boxes and other boxes may be used in the same way but they should be reinforced with extra nailing and lined with galvanized iron. Long boxes with tapering sides and ends are always satisfactory and are not much more difficult to make than the more commonplace rectangular ones. The illustrations will suggest various ways of constructing the stands.—MATTHEW MEK. WRIGHT.

Attractive Garden Seat

(Continued from page 84)

securely if driven straight in the end grain. The rail is nailed to the sides and also to the seat. Then the stretcher is fastened.

The lower piece of the back is beveled to give the back the right slant and nailed in place. Turn the bench over and nail the seat to this piece. Insert the spiats, put on the top piece, and nail securely.

The bench should now be firm and solid. However, if the nailing is not thought adequate, the bench may be further strengthened by the addition of two angle irons screwed tightly in place on the top side of the stretcher. The projections where the lower tree forms the legs of the bench may be reinforced by thin cleats nailed or screwed on inside.

To finish the bench, shellac all knots and give a priming coat of the desired paint. Then putty the nail holes and any checks or cracks. Two coats of good outside paint should be applied before putting the bench into service. As the writer's home is trimmed in sage green, he finished the bench in the same color.

Two-Way Block Systems for Model Railways

IN OUR December issue there appeared an article showing how to make an automatic block signal system for model railways. The diagram and instructions gave constructional details and wiring directions for a system that would work with the trains running in one way only. A prize of $5 was offered for each of the methods showing how to make the system work in both directions by means of electric switches that were deemed by the judges to be worthy of publication

Hundreds of entries were received giving methods of solving the problem in almost every conceivable manner From among these the diagrams shown in Figs. 1, 2 and 3 have been selected.

Many variations of the hand-operated electric switch were submitted ranging all the way from complicated methods employing eight pole, double-throw switches to the simple and practical

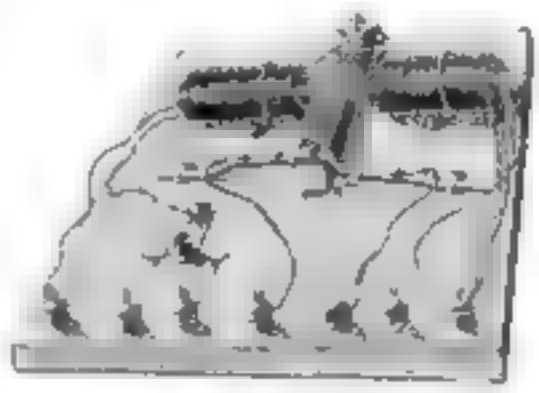


Fig. 1. A simple and practical circuit contributed by Lee C. Evans of Cleveland, Ohio. Note the two-point control switch

Fig. 2. Marvin Moore, of St. Joseph, Mo., makes use of an electrically operated switch

circuit shown in Fig. 1, which was devised and sent in by Lee C Evans of Cleveland Ohio.

Essentially the circuit of Fig. 1 is the same as the original one-way diagram except that a simple two-contact switch has been added on the baseboard of the automatic controller, as well as another binding post and two extra track contacts.

Passage of the locomotive over contacts W or Z will allow current to flow through magnet B and close contacts D and E, which will light the green signal and send current to insulated third rail section O. The two-contact switch is thrown by hand in the direction of train travel so that either contact X or Y will be ready to send current through magnet A and cut off the current to third rail section O and light the red lamp. You will note that throwing the switch in the direction of train travel results in connecting the one of the two contacts X or Y which is at the far end of the insulated section as determined from the direction of train travel.

Contacts W and Z should be placed at equal distances from insulated section O, so that the following train will have passed W or Z, unless it is so far behind that the first train has passed over the other contact and thus opened the block.

Walter Gibson, also of Cleveland, Ohio, sent in the simplest diagram for an automatic system that requires no extra switches whatever It is shown in Fig. 3. In this arrangement, two insulated sections marked O and OO are employed in conjunction with three track contacts. Assuming that contact Y is closed, a train approaching in either direction will pass over the insulated section and run on to the permanent live section between When it reaches the center of this section, it strikes contact B, thus cutting off current from both the insulated section in front of it and the one behind it. Both these sections will remain dead until the first train has passed to the end of the center section where it strikes either A or C depending on which direction it is traveling, whereupon the current flow to section O and OO will be restored, allowing the first train to get out of the block and the following train to enter it.

This system, while simple and ingenious, is not to be recommended for small track layouts, because of the space taken up by two insulated sections and the need for making the center live section long enough to afford a sufficient time interval to block

(continued on page 87)

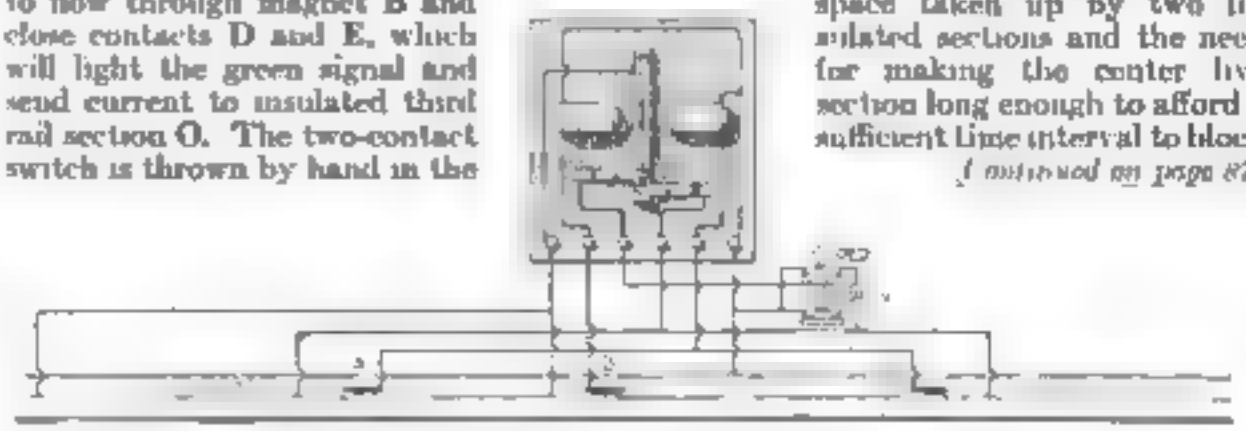
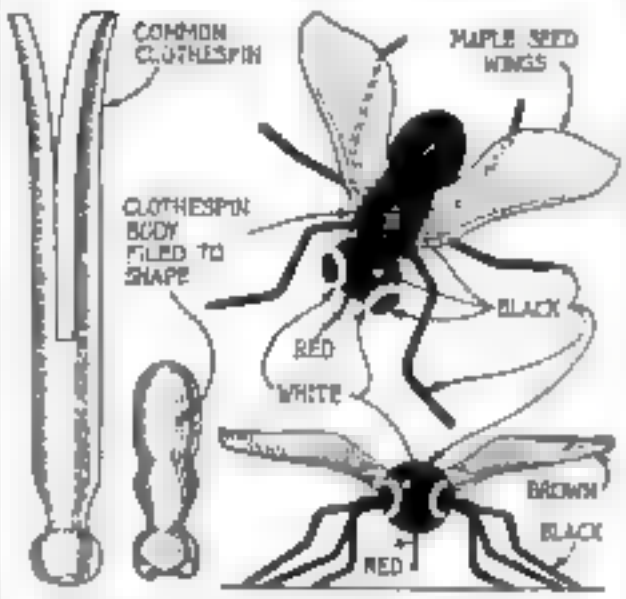


Fig. 3. No extra switches are needed for the automatic system contributed by Walter Gibson of Cleveland, Ohio He makes use of two insulated track sections and three track contacts

A "Comicull" Fly with Maple Seed Wings

By F. Clarke Hughes



Winged seeds of maple trees will serve for constructing many curious insect models

THIS fly is made from a clothespin, two maple seeds and six lengths of electric bell wire. The legs are placed in holes in the body and, like the wings, are fastened with glue or sealing wax. A coat of clear varnish or shellac is applied to stiffen the wings.

Two-Way Block System

Continued from page 86

the following train. In addition, it may fail if the following train is too close to the train in front as the rear train is likely to coast over the end of the insulated section. However, it will work perfectly on a large layout if the difference in speed between the trains is not too great.

Curiously enough, a modification of this system with two B contacts, one near contact A and the other near contact F, was sent in by many readers. The extra contact should overcome theoretically the objections to the system of Fig. 3, but the extra contact would make the system unreliable because the contact rollers on unusually light toed passenger cars might throw the switch after it had been set by the locomotive.

Of the diagrams showing an electrically operated switch to change the direction of operation, that submitted by Marvin Moore of St. Joseph, Mo., certainly is ingenious and simple for this type of control. Figure 2 shows the wiring arrangement. As you will note by following out the wiring track contacts A and F operate the left-hand automatic switch so that a locomotive approaching from either direction automatically shifts the connections to the blocking contacts C and D to put the correct one in circuit for the direction of train travel. This system automatically accomplishes the results obtained by the hand-thrown switch of Fig. 1.

Many diagrams were submitted that showed automatic operation with switches fitted with from eight to sixteen contacts on the moving arm. While such systems may work the amount of power is rather limited with alternating current, and it would be an exceedingly difficult matter to get the magnets to work a switch arm with so many contacts.

How to Fix Gardening Tools

Sharpening, Cleaning and Oiling Lawn Mowers Repairing a Hose—Rakes, Hoes and Spades

By Robert S. Lewis

NOW is the time to fix the lawn mower, hose and gardening tools and forestall those sudden breaks which always come at "just the wrong time."

First, the lawn mower. It is sure to need a good oiling. Use a heavy cylinder oil, such as for motors; light oil doesn't stay "put." If the mower runs hard, try flushing the wheels out with kerosene, pouring it into the circular opening and draining into a dish pan. Now run the mower a few yards, and then oil thoroughly.

When the mower is dull or out of adjustment, it leaves ridges and uncut grass. The blades and bottom knife can be lightly and very carefully touched up with a fine file. Another method is to reverse the driving pinions so that the mower will run backward and apply grinding compound on the cutter bar. This was described in the May, 1926, issue of POPULAR SCIENCE MONTHLY. If the mower is thoroughly dull, it is best to send it to an expert to be sharpened.

At the beginning of the season the lawn mower should be overhauled and thoroughly cleaned

Sometimes the bottom blade gets out of line and the revolving knives fail to shear along the edge. The bottom blade can be reset, usually by loosening one screw and tightening another at each side of the machine.

EVERY second or third season the mower should be sharpened, adjusted and generally overhauled, but choose a shop where there is a machine for properly grinding the revolving knives.

The chances are that your hose needs attention. Connect it to a tap and close the nozzle tightly; holes or thin places will show by spurts of water or damp places. Ordinary leaks can be fixed with friction tape, wound tightly with about a three-quarters overlap, and doubled. Coat the winding with shellac.

While very bad holes can be mended with tape, it is better to cut out the rotted parts and insert an inner sleeve, first putting on some shellac. Be sure to get the right size of sleeve for your hose. Work it halfway into one piece, insert it into the other end of the hose, and finally fasten with regular hose clamps, one on each side of the joint. Wire also can be used, preferably soft or annealed. A piece is bent double and the loose ends are inserted into the loop and tightened with pliers just enough to prevent cutting the hose.

End fittings tend to come loose and leak. Tightening the clamp, or cutting off the hose and reinstalling the fitting, will make an end as good as new.

Draining the hose after use and hanging it up in a dry place will delay rotting and leaks.

Wooden handles of garden tools tend to shrink and the metal heads will come loose. A thin wedge of metal or wood can be driven alongside the shank. A permanent repair is to drill a hole through both handle and shank, using a drill just large enough to admit a 6- or 8-penny nail. Cut off the excess length and rivet the cut end.

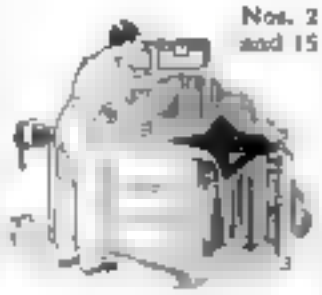
ROTATING sprinklers that won't rotate may need a little heavy cup grease on the bearing parts to reduce friction.

A file or emery wheel will soon put an edge on hoe, spade or other tools. A few nicks in the edge do not matter. Sickle and shears can be ground on an emery wheel and finished with an oilstone. Follow the original bevel and get a clean, new edge. Rubbing the metal parts of tools with an oily or greasy rag will prevent rust, as will a coat of paint each season.

A breast drill and a spike will enable you to play dentist to a broken rake. Drill a hole where the broken-out tooth was, just large enough to allow a spike to be driven in. Heat around the hole, then carefully drive in the spike. When the metal cools, the new tooth will stay in place. The spike can be slightly offset to prevent its working back through the hole.

Many rakes are made of rather fragile cast iron, and must be used and repaired with care to avoid breakage. A rake with a broken back can be repaired by laying a piece of stiff strap iron over the break, drilling at least two holes each side of the break, and fastening with stove bolts. Another plan is to cut slots in a piece of strap iron to fit the teeth and slip it across the break, wiring it to the back.

Blueprints for Your Home Workshop



Nos. 2 and 15

ANY ONE of the blueprints listed below can be obtained for 25 cents. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine, in which the project was described in detail, it can be had for 25 cents additional so long as copies are available. The Editor will be glad to answer any specific questions relative to tools, material, or equipment

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POPULAR SCIENCE MONTHLY
2381 Fourth Avenue, New York

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Send me the blueprint, or blueprints, I have underlined below, for which I inclose dollars cents

No.	Title	Issue	Year	Price
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3.	End Table	Apr.	'27	25c
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5.	Sewing Cabinet	June	'27	25c
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7.	Porch Swing	Aug.	'27	25c
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42.	Pirate Ship—Details	Mar.,	'26	25c
43.	Galleon Model—Hull	May	'26	25c
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This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

How to Solve Block Puzzles

Clues to Their Assembly Two "Chinese Crosses"

By Arthur L. Smith

Block puzzles appeal to the mechanical man, for he can whittle them to endless varieties

READERS of the preceding articles on the block puzzle, otherwise known as the "Chinese cross," may be interested to learn that it is possible to tell by simple inspection of six blocks or their drawings whether they will fit perfectly or have an internal cavity. This may be known even if the combination be unfamiliar and though the solver may not be able to put it together.

A very intricate 30-block puzzle of the same character as the one described in the October, 1926, number of Popular Science Monthly was sent to the writer for solution after the publication of that article. The owner had never succeeded in assembling the pieces. There were no two combinations alike for any of the eight corners nor the inclosed cross, which had no key block. There were only two key blocks for the external portion instead of four. By inspection of the cuts, it was clear that there would be internal cavities in some of the eight corners. These were necessary to allow certain blocks to slide a short distance to enable other corners to be assembled. By assigning numerical values to the various cuts, pieces could be laid out in which there was a possibility of their going together. This soon resulted in a solution, which might otherwise never have been reached or which at least would have taken a very long time by an aimless fitting of pieces together. A description of this process may be of help to others who have puzzles of like character which they cannot assemble.

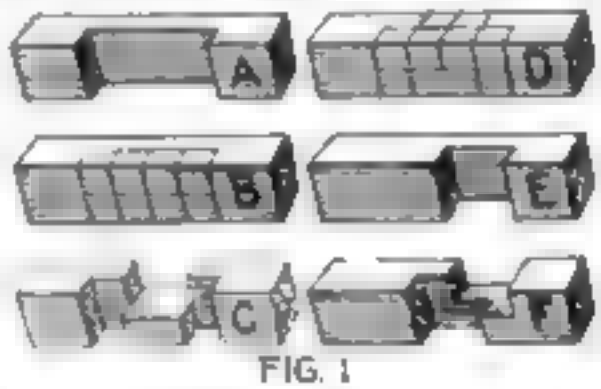


FIG. 1

The blocks illustrated are each ¾ in. square and 2 in. long. Block A (Fig. 1) has a cut ¾ by ¾ by 1 in. We can imagine this cut to be filled with little ¼-in. cubes as shown in the figure below, B. We give it a numerical value of 8, corresponding to the number of cubes required to fill the cut. In the manner block C requires 8 cubes, as illustrated in D, and has the same numerical value. Block E requires 4 cubes and has the numerical value 4. Block F requires 7 cubes and has the value 7. A plain block, as G (Fig. 2), is given the numerical value 0.

If we take A A C C and E E we find their total is 40. Every Chinese cross puzzle (Fig. 4) that fits perfectly must have this value of 40 estimated in little cubes of which each of the three dimensions measures half the width of the block. This rule holds good no matter what the size of the blocks may be. There is, then, a possibility of (Continued on page 91)

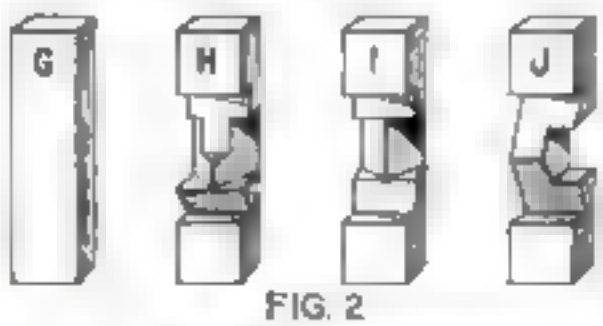


FIG. 2

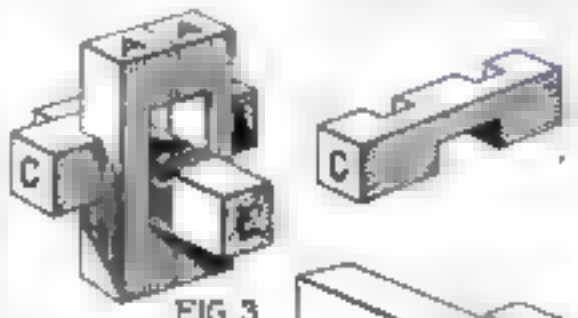


FIG. 3

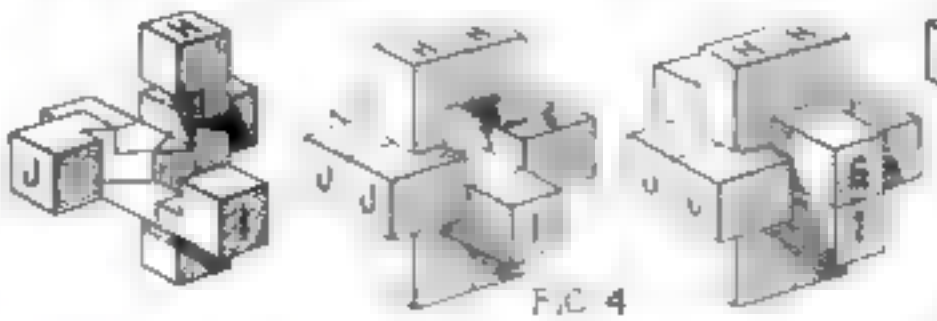


FIG. 4

FIG. 5

To form a "Chinese cross," blocks A A C E (Fig. 1) are assembled as shown in Fig. 3 and blocks C E are slid into place. The blocks in Fig. 3 are put together as in Fig. 4

Solving Block Puzzles

Continued from page 90

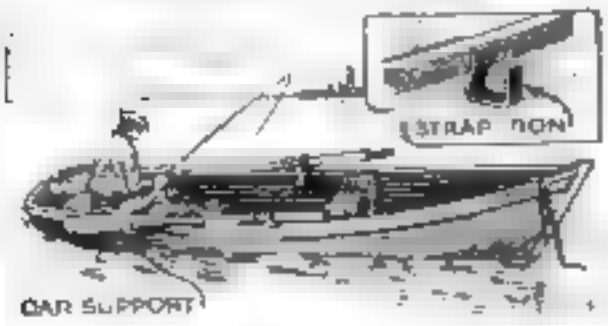
blocks A A C C and E E fitting together perfectly and we find that they may be assembled though there is no key block. Fig. 3 shows how it is done.

It does not necessarily follow that if the numerical value of 6 blocks is 40 that the pieces can be put together. The cuts might not be in the right position or they might be of the wrong character. It is well to remember that the principal cuts must face one another. While we cannot be assured that the pieces will go together if their numerical value is 40, we do know that if they do not there will be no internal space to fill. Also, if the total is less than 40 we know at once that a solution is impossible. If the total is more than 40, there will be an internal cavity equal in content to the number of cubes above that total. Thus, if we take blocks A A C C E and F we have a total of 43. These blocks can be assembled and no internal cavity will be apparent, but there will be one equal to 3 cubes.

IF THE cuts be irregular in shape it may be difficult to determine their value, but the rule holds good that the amount of material cut away must be equal to 40 cubes in the most economical way out of the solid of the blocks. In Fig. 2 blocks are illustrated with wedge shaped or angular cuts. It is not difficult in this case to find their value, for two of the wedges placed together form a rectangular figure equal to 1, 2 or 4 cubes. It is comparatively easy to count the number of cubes found to have a numerical value of 7 in Fig. 1 of 10, and 1 of 7 in Fig. 2. Taking H H J J I and the part back of them we have a numerical total of 40. Fig. 4 shows steps in the process of assembling them.

Those who have enjoyed Sam Loyd's interesting brain-teasers can find one quite confusing to many folks in this question of the amount of material cut from the blocks. If all the external parts of a Chinese cross be removed it would leave a solid like Fig. 5, which would consist of 32 small cubes instead of 40. This represents the cubical contents of the internal part, yet 40 cubes must be cut from 6 blocks and when fitted together no internal space is left! How can you account for those 8 extra cubes?

Oar Supports for Rowboat



Strap iron holders are screwed to the fisherman's boat to hold the oars out of the water

MANY a fish is lost because the line gets entangled around an oar dragging in the water. Likewise, oars are in the way if they are lifted into the boat. A simple method of overcoming this fault is shown above.—ROBERT PAGE LINCOLN

A Boy Can Build This Boat

(Continued from page 91)

mill for ten or fifteen cents. Keep the waste pieces as they will be useful later on.

The shaping of the hull is the next step. First screw a block of wood to the deck-side on the center line. This will enable you to hold the block conveniently in the vise. The tools necessary for this operation are a drawknife, a 1-in. chisel and a small (block) plane. These tools must be sharp. Five or ten minutes spent in putting a keen edge on your tools with an oilstone will be saved many times over in doing the work.

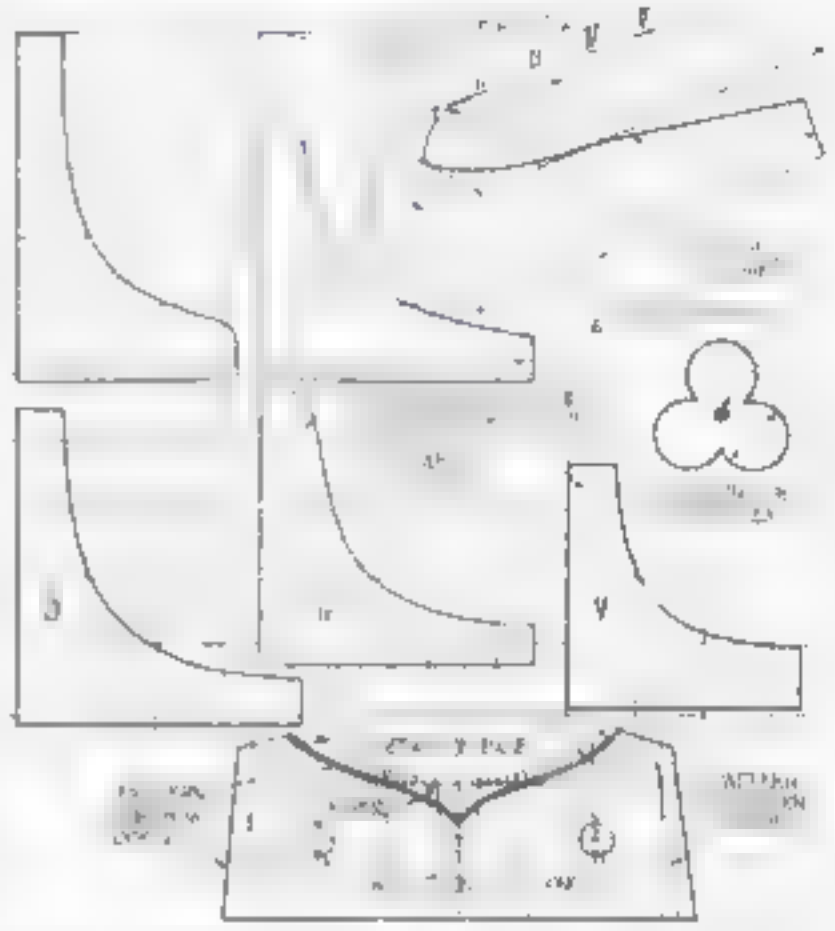
Begin by cutting about amidships with the drawknife and working toward the bow. As you find the hull is beginning to shape up, use the cardboard templets frequently. Be careful not to cut too deep. You can always remove surplus wood, but never add any. Change over from one side to the other as necessary. Then finish this part of the hull by using the chisel and block plane.

Next work from amidships to the stern in the same manner testing with templets III, IV, and V.

After all the tool work has been completed, begin sandpapering with No. 1 sandpaper, following with No. ½ and finish with No. 00. See that all tool marks are removed.

Gouging out the inside is the most difficult part of building the boat, although it will not give you much trouble if you use a reasonable degree of care. Boys are so impatient to get the boat done that they are apt to put some holes right through the hull. Be cautious and work slowly.

Prepare a cradle to hold the hull such as is shown in one of the photographs on page 73. This is made from the waste pieces cut off when the hull was bandsawed to shape. Fasten them with nails to a baseboard of any heavy stock.



How the hull block is marked for sawing templets to and in carving it patterns for cutting the projecting sections or stand

Draw a line ¾ in. from the edge of the boat on the deck and another ¾ in. from the edge. The last line will serve as a center line for boring a row of holes with a ¼-in. auger bit. Bore these holes as deep as you think it safe to do around the deck and, of course, have them overlap a little as it were, so that the waste wood in the center will be separated from the sides of the hull. This makes the gouging process much easier.

Use a ½-in. gouge to hollow the hull as completely as possible. The side walls should be ¼ in. or less in thickness; the bottom is left somewhat thicker, as shown by the dotted line in the side view of the boat.

Give the inside several coats of white lead paint or orange shellac and apply one coat of the same to the outside.

Make a deck for the sum of 5 cents from cigarette or

(Continued on page 94)

Deck view or plan of half the boat, the complete side view, and details of hatchway, ventilator, tiller and railing. These drawings appear full size on Blueprints Nos. 63 and 64, see page 89

A Boy's Motor Boat

Continued from page 93

cedar, if obtainable, and a similar deck for the stern of white pine. Allow ¼ in. overhang for finishing. Glue and nail these pieces to the hull and plane down to the finished size.

If floor lines are wanted on the fore deck, it is best to lay these out beforehand with a marking gage on a rectangular piece of wood 6⅞ in. wide and then cut it to the shape of the bow.

The fore deck has an opening for the hatchway. The latter is made as shown in the drawings and can either be glued to the deck, or small brads may be driven in the bottom edges, cut off and then used as dowels, pressed into the deck. This method has the advantage that the hatchway can be removed easily to look into the hold of the boat. Note that there is a ladder under the hatchway. It is an optional detail, as is the ladder leading into the cabin.

THE keel, which is cut from a piece of white pine ¾ by 1 by 10½ in., is fastened with glue and brads of different lengths. No nails, of course, must be driven through the keel near the wide part toward the stern because a ¼-in. hole is to be drilled through it for the rudder shaft. This hole should be sawed very carefully with a keyhole saw or jigsaw but use the same bit to drill the hole through the deck and hull for the rudder. Put a seamless brass tube ¾ in. in outside diameter in these holes for the rudder and propeller shafts. One tube will be 3¼ in. long, the other, 2¾ in.

It is best to build the stand next as it will make working on the boat more convenient from this point. The stand consists of two cradles of the shape shown full size on Blueprint No. 64 and on a small scale in the illustration on page 92. These are connected by two ¾-in. dowel sticks 12 in. long.

Inside the hull at each side glue two steps ⅜ by ½ by 12¾ in. Their upper edges should be ¾ in. below the deck line. These are the cleats upon which the cabin is to rest.

THE cabin itself is a separate unit and it may be made next. It should be constructed of mahogany or some other hard wood that will look well when varnished. The sizes of the pieces are all indicated on the blueprints. Cut them out, one unit over the windows on the inside and nail the parts together with ¾-in. brads.

You will see that there is a truss across the cabin between the second and third windows. This can be lightened by cutting a piece about 1 by 3½ in. from its lower edge in the form of an archway.

As a finish for the cabin I use dark mahogany stain, which is allowed to dry twenty-four hours. This is followed by two coats of white shellac. Each coat is rubbed down with steel wool. After the last coat, floor wax is rubbed on and polished with a piece of clean flannel. This gives a good finish and is not hard for boys to do. The fore deck is finished in exactly the same way.

Now you are ready for the rudder, which I like the

Continued on page

A Boy Can Build This Boat

(Continued from page 93)

propeller, is made from sheet brass of from No. 18 to No. 22 gage. Galvanized iron may be used instead of brass. The rudder is soldered to a shaft made of 3/16 in. outside diameter brass tube. Split the tube with a hack saw, or fine back-saw, place the rudder in the slot, and solder it well.

The tiller also is made from brass and soldered to the upper end of the shaft. Note that a quarter turn is given to the end of the tiller so that it can engage the slots cut in the tiller support. This construction is made clear in the drawings.

Something that will serve as a knob on the upper end of the shaft probably can be found in your junk box; a knob from a discarded loose-pin hinge, if not too large, will do nicely.

THE propeller can be made in various ways. One of the simplest is that illustrated on page 94. It can be bent to work either right or left hand, as required by the motor.

The power plant is an inexpensive toy motor of the 2 to 4 volt variety.

Drill a 1/16-in. hole in the exact center of the propeller. Place it on the propeller shaft, which is made of 1/16-in. brass tubing about 13⅝ in. long. Then place a small brass collar on the end of the shaft and fasten all firmly with solder.

It is always interesting to experiment with propellers of various shapes and pitches. The secret of getting speed out of a toy motor boat often lies in the propeller. A rapidly turning propeller with little pitch develops the most speed. It depends considerably, of course, upon the motor and other factors, but if you wish to experiment in this direction, you might try a two-bladed propeller with narrow blades, bent so as to give as perfect a screw action as possible. The main advantage of the three-bladed propeller illustrated is that it is very easy to make and foolproof under all circumstances.

THE shaft is fastened to the motor by means of a small spring, as shown. This spring serves as a universal joint and makes up for any misalignment of the shaft and motor. If the 1/4-in. tube is left long enough, it will take the thrust of the propeller on the end; otherwise the thrust is borne directly by the motor, through the shock-absorbing spring, which is not, perhaps, as good practice, but works satisfactorily nevertheless. Indeed, it is surprising how much looseness and misalignment of parts there can be and a boat will still run speedily.

An inexpensive toy motor of the 2 to 4 volt type is fastened in the cabin as shown. For power, a 4½-volt radio C-battery is used or, better still, two 4½-volt C-batteries wired in parallel. A switch may be placed in any convenient position, or the switch on the motor may be used, if there is one on it. A good idea is to place the switch on the rear deck in such a way that moving it toward the stern of the boat will open the circuit. Then, merely by tying a light fishline to the switch handle, it is possible to stop the motor at any point by giving the line a jerk, whereupon the boat can be pulled backward to the shore.

Lights are not necessary, but help the appearance of the boat. Two flashlight bulbs can be pushed into holes in the roof of the cabin and wires soldered to them. A flashlight battery for lighting them is fastened to the underside of the cabin by means of a small brass cap. A homemade switch can be devised for turning on and off the lights. Other additions can be made as suit the builder's fancy, such as lights on the cabin, wireless masts, flagpoles, and the like.

It is obvious, of course, that the cabin and deck could be made much higher, the top of the cabin could be rounded a bit and many refinements made. These will improve the appearance of the model, but the boat as illustrated has purposely been kept simple and sturdy, so that it will both be easy to construct and will stand up under severe usage.

THERE are many ways of finishing the hull and you can, of course, select what colors you prefer. After many experiments, I have found the following method satisfactory.

First apply two coats of a gray undercoat made for use under brushing lacquer. The first coat is allowed to dry four hours and the second, eight hours. Each is rubbed with very fine sandpaper, preferably No. 00. Then two coats of white or French gray brushing lacquer are applied to the hull above the water line; two coats of red, green or dark gray below the water line, and two coats of French gray to the rear deck.

Automobile enamels may be used instead of brushing lacquer or oil paint with a final coat of spar varnish, but any process using varnish or enamel will take much longer, of course, than one using quick-drying lacquer.

All the metal parts, such as the grommets used in the port holes, the railing, which is made of brass wire and brass screw eyes, and the tiller, are finished in gold enamel. The stand is painted with brushing lacquer like the boat, and has strips of rubber from an inner tube tacked to the cradle surfaces.

How to Mix Plastic Finishes with Flat Wall Paints

PLASTIC paint for decorative purposes can be prepared by mixing 1 qt. of flat wall paint of any desired color, 1 lb. of plaster of Paris, ½ lb. of boiled whiting and about ½ pt. of varnish of the best quality. If a thicker mixture is desired, it is necessary merely to add more plaster of Paris and whiting in the proportion of two parts plaster to one part of whiting. This mixture can be made in larger quantities and used for finishing walls in the same way as prepared plaster paint, when the latter cannot easily be obtained.—L. T. S.

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

PAPER can be used for many things besides writing, wrapping and printing. It can be made to act as a preservative and as a means for preventing the tarnishing of silverware. It may be made waterproof, fireproof and fat proof. These are only a few of the many and varied uses of specially treated paper.

Wax paper, for instance, is used as a wrapper in cases where the product to be kept has a certain percentage of moisture that must not be lost by evaporation.

A paper which, when wrapped about silverware, prevents the production of tarnish may be prepared quite readily. Ordinary paper is well adapted for this, although other light or even heavy papers may be used. The paper is merely dipped into a bath of salts and then dried, after which it may be used.

Treating paper with borax and shellac

The bath is prepared by dissolving 1 teaspoonful of lye (caustic soda) in half a glass of water and adding ½ teaspoon of red oxide yellow lead oxide also may be used. Heat the mixture in a water bath (double boiler) until all or nearly all of the crystals have dissolved. About two hours will be sufficient for accomplishing this. Cool the mixture, pour the top solution from the sediment, and dilute the solution with a little less than half its volume of water. Thoroughly saturate the paper with the cold solution and let the excess drip back into the container, as the solution will keep it carefully corked. Hang the paper up to dry, when it will be ready for use.

A waterproof paper, which is also proof against many fats, is prepared by dipping or brushing the surface with a concentrated solution of borax in which shellac has been dissolved by gentle heat. Any fine colors may be added to give the paper any desired tint.

A rust retarding paper also can be made at home. All objects wrapped in it will be prevented from rusting for a certain length of time. The paper is brushed with a light oil, such as sewing machine oil, or petroleum. When iron or steel objects are wrapped in such paper, the slight evaporation of the mixture will place a film of oil over the metal.

Paper will burn only when exposed to high temperatures if it is prepared by dipping it in a hot solution of 1 teaspoonful of ammonia sulphate, ½ teaspoon of borax, and ½ teaspoon of boric acid in a small glass of water

Our Viking Ship Takes Shape

(Continued from page 80)

everything he had went down with a seventh slip.

To return to the inside of the model, it should be quite open with a platform at either end, with the sides as thin as you can comfortably make them.

The platforms may have a very thin deck glued on to them to cover the joints. To make these, cut pieces of cardboard until they fit and use them to mark the wood.

In the open part are imitation frames or ribs. There really should be seventeen of these, but nine will be sufficient in our model. The easiest thing to make them of is rattan cane, such as chair menders use. A bare 1/8 in. wide by half that the knees will be about right. Chip one end of a piece into the corner of the rabbet under the edge of the hull proper, bend it around the inside of the hull and cut it to chip in the rabbet on the other side. These ribs are placed equidistant between the platforms. When each one is cut to size, glue its underside and hold it in position with your clothespin clamps until dry.

The model makes an unusual and brilliant decoration for master shelf, chest, or console table

Above each of these frames set a horizontal beam or thwart for transverse strength. Cut them to touch the gunwales at either side, and notch them underneath to fit on the edges of the hull proper. They should be about 3/4 in. square. These are not seats; the rowers evidently stood to row in what is still known as "North Sea fashion."

To each of these beams erect short pillars along the midship line of the vessel. These should be a shade larger than the beams and should be notched on to the frames and the beams, projecting above the latter about 1/8 in. The projecting points may be chip-carved with notches, by way of decoration. These short posts go to beams 1, 3, 4, 6, 7, 9, counting from forward. The two center ones must be laid aside until the mast step is placed in position as described later.

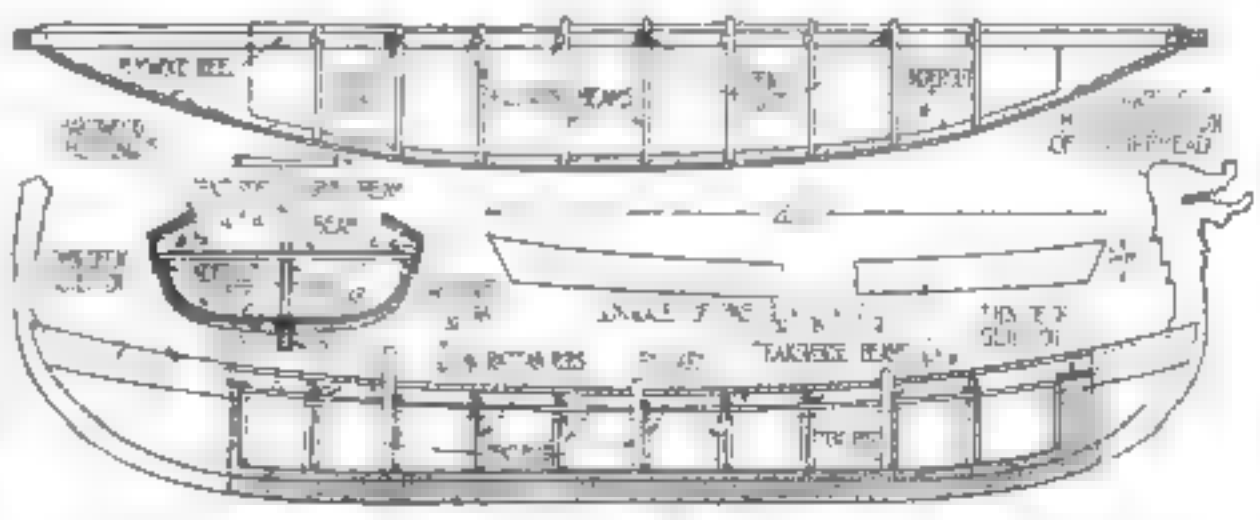
To the other three beams come longer and heavier posts, which support the ridge poles for the tent or awning. These posts or stanchions are 3/4 in. square. They are notched like the shorter ones, but project 3 1/2 in. above the beams. Athwartship on top of these should be mortised a crossbeam, the same size in section and 1 1/2 in. long, with fishtail ends and a downward curve in the middle.

The sides of these posts and crossbars should have concentric circle ornaments carved or burnt in them. There is to be a little bit of ornamentation on our ships and the best looking and most accurate method of doing it is to burn it in. There are poker work or burnt leather work tools obtainable for this purpose, but any heated steel point will do it, such as the end of an old file. First, of course, draw the design on the wood with a pencil.

These three posts should be laid aside for the present.

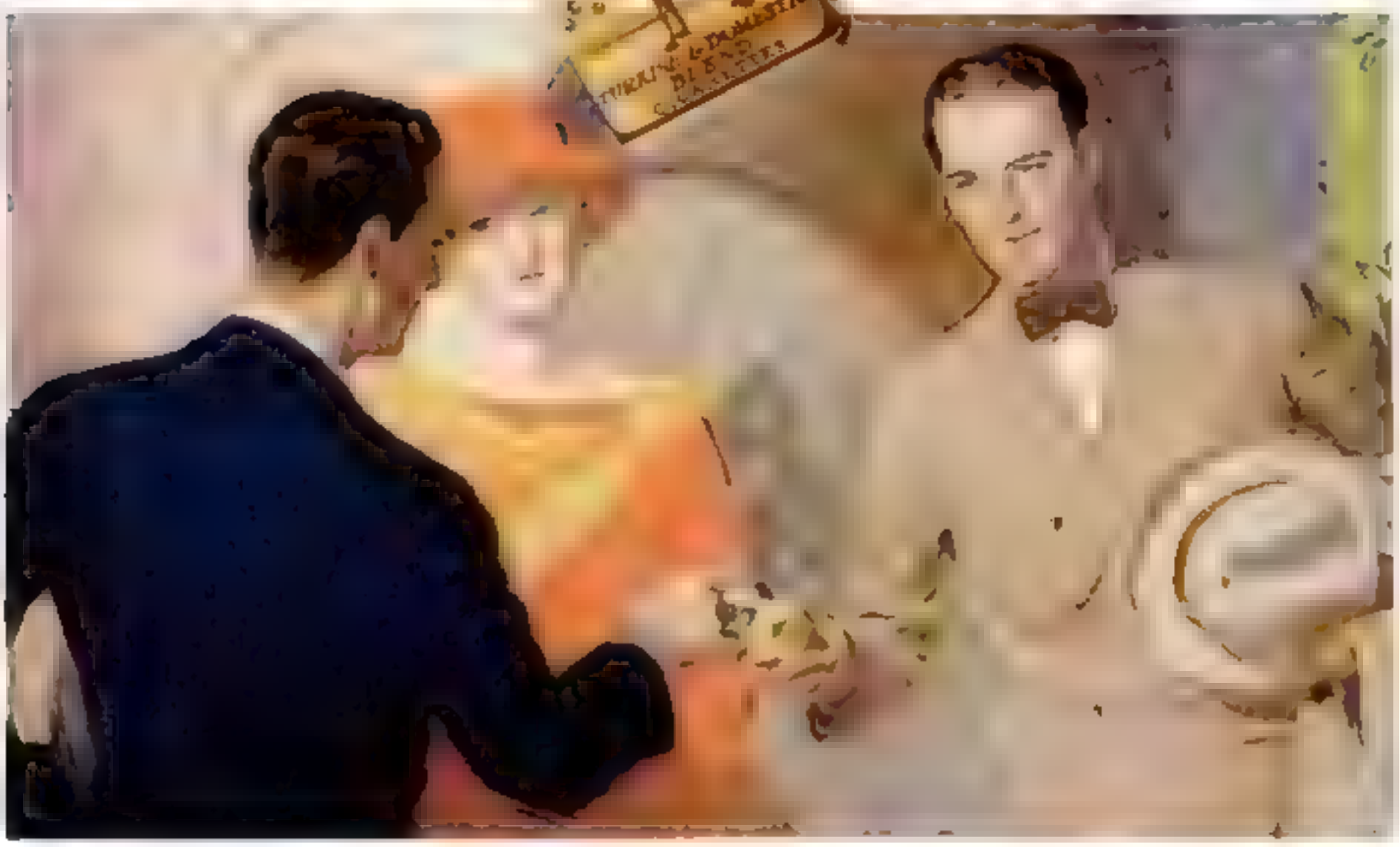
Almost any hard or semihard wood will serve for making these small parts. If a light wood such as poplar or lime is used, it will be stained later. Oak is unnecessarily hard and open grained; cedar, mahogany and holly are good but need staining. Walnut is about the best, but I used a piece of the lid of a China tea chest, which I found was made of a fine grained wood, that held nails and carved easily.

Pierced through the gunwales are sixteen holes 1/8 in. in diameter for the oars. The positions of these should be marked from Blueprint No. 61 or spaced about 3/4 in. apart. There is one on either side of the midship line and the others evenly spaced along, seven abaft and nine before that mark. They should be just above the level of the (Continued on page 97)



How the gunwales, notched molding, ribs, beams, pillars and tent supports are added to the hull. Full size details of these and other parts appear on Blueprints 61 and 62 (See page 89)

H A V E A C A M E L



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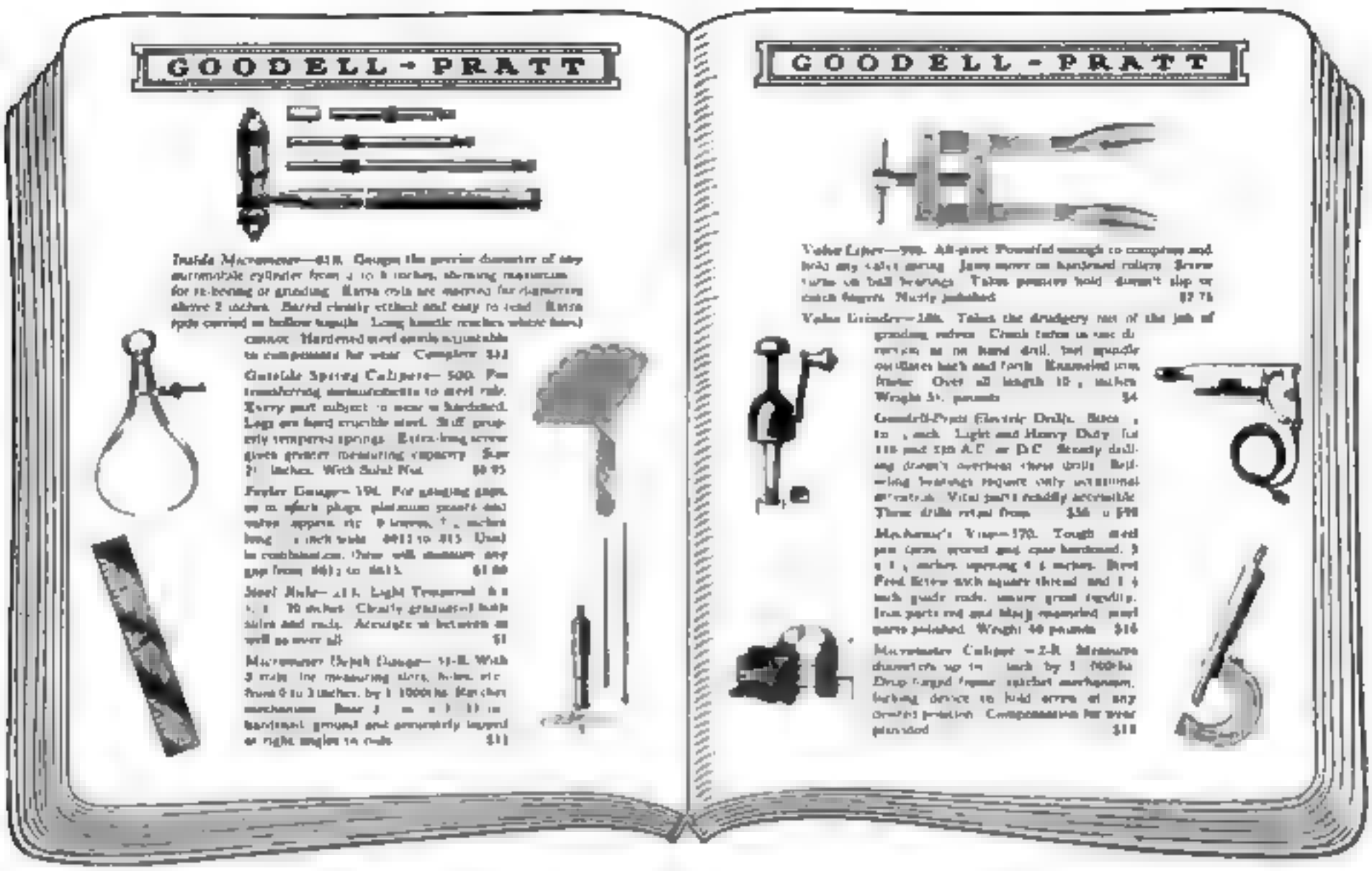

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1500 GOOD TOOLS

Our Viking Ship Model

(Continued from page 86)

top of the body of the hull. None of them should go through exactly where the beams lie.

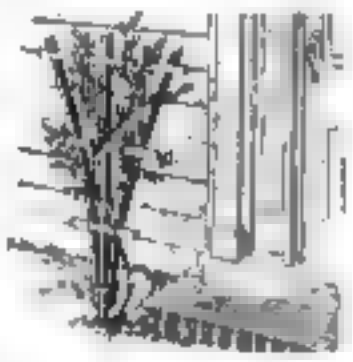
Along the inside top edge of the gunwales there is a bead molding. This should be a full ⅜ in. wide by a bare ¼ in. thick. It may be made of white pine. Cut the ends to an edge so that these pieces spring into position tightly. Make a mark on them directly above each oar hole. Remove them and mark as shown on page 90, that is, so that the molding has full thickness over the oar ports and for a space exactly between them, with equal sized necks between. The important thing is that there is full thickness where the tholes, or short posts for the oarlocks, are to come. When marked, they can be glued in position. Be careful that they are not lower than the edges of the gunwale, to which level their edges can be sandpapered.

That is all we can do to our Leif Varnson's long serpent in this issue. The rest will be easier and possibly more interesting because we will be making simple carvings and applying the colors.

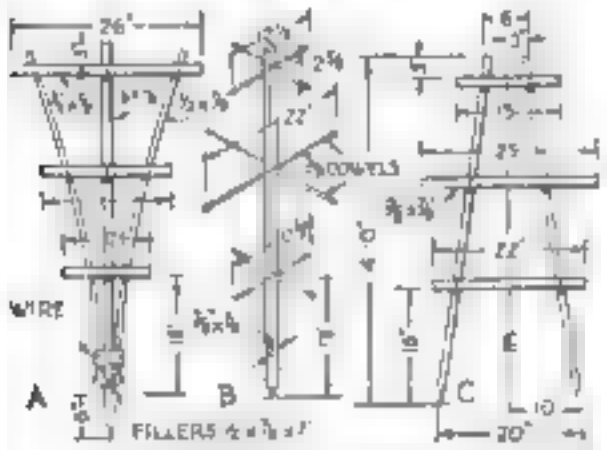
How to proceed from this point will be told in the June issue.

Easily Made Trellises

ANY handy man or boy can make the three trellises illustrated at little cost. The wood should be cypress, white pine, cedar or some other kind that is durable when exposed to the weather.



To make these trellises you will need some strips of wood ½ by ¾ in., ¾ by 1 and ¾ by 1½ in., and a few ¾-in. dowels. Heavier stock can be used, if you prefer



In making trellis A, fasten the uprights and fillers with brads and wind on the wire. The side braces then may be sprung and held temporarily with nails while the three cross cleats are fastened.

Trellis B merely requires some care in boring. When assembling C, lay out the parts in correct relation to a center line, which may be a crack in the floor and then nail the lattice strips in place.

Give the trellises two coats of white or green oil paint.—C. A. K.

The SHIPSHAPE HOME

Replacing a Common Snap Switch with a Flush Switch

By GEORGE A. WILLOUGHBY

TO REPLACE a common snap switch with a flush switch is a relatively simple undertaking for the amateur electrician. First open the main house switch. Take off the knob and cover of the snap switch (Fig. 1), disconnect the wires and remove the switch entirely.

A hole must be cut in the wall for the switch box required for inclosing the new flush switch. This metal case is to be fastened to the lath or to a wooden cleat with wood screws which pass through holes in the "ears" of the box.

Three important points must be kept in mind. First, the hole must be just large enough to receive the box, but small enough to be covered completely by the switch plate or cover. Second, the horizontal location must be such that there will be no wall stud to interfere with the box. Third, the upper and lower limits of the hole in the plaster must be so located that solid lath will be in the position where the screws are to be placed.

Remove some plaster immediately around the loom-covered wires and probe

Fig. 1. The cover is removed and then the snap switch is disconnected and taken off

with a screw driver to see that there are no studs to interfere. Place the switch box against the wall and draw two short lines—not the whole length of the box (Fig. 2). A sharp screw driver or knife, when used for marking, will cut through the wall paper and nick the plaster. Remove some of the plaster between the lines with a screw driver or chisel and then locate the upper and lower limits of the switch box opening to suit the laths. Bore holes in the lath to be removed for starting a keyhole saw (Fig. 3). Do not cut clear through the lath, but leave a fifi-

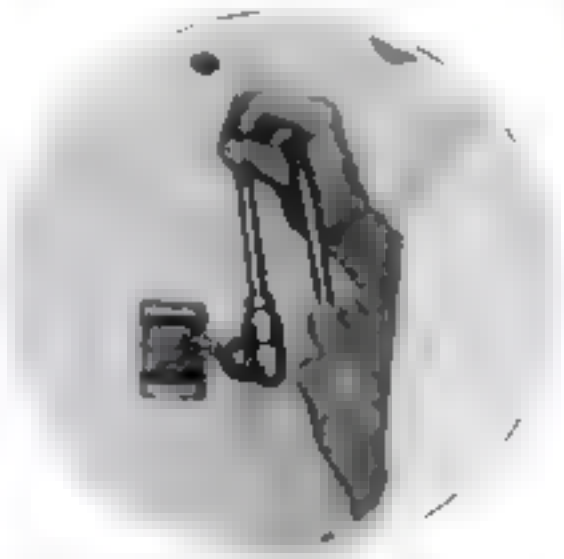


Fig. 3. When the plaster has been removed, a hole is bored at each side of the lath

Fig. 4. Cuts are made with keyhole or compass saw to remove the obstructing lath

cient to prevent the lath from moving excessively while the second cut is made.

Clean out the opening, remove the knock-outs from the box to receive the loom-covered wires, bring the wires into the box, clamp the loom in place, and attach the box with wood screws. The remaining steps in installing the new flush switch are exactly as described on page 84 of the April issue.

Fig. 2. Marking on the wall the width of the box for containing the new switch

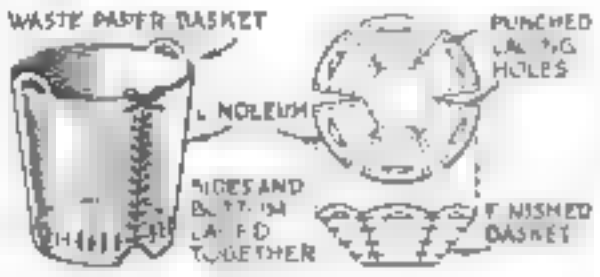
How to Varnish Wall Paper

WHEN ordinary wall paper is used in a child's room or in any other room where it is apt to become badly soiled, it can be given a coat of white damar varnish to protect it and to allow it to be cleansed with a damp cloth. The varnish may be mixed with turpentine to reduce the gloss, even to the extent of two parts of turpentine to one of varnish. It is best to apply a preliminary coat of glue size made by soaking ¼ lb. white glue over night in a little water and adding 1¼ qts. boiling water.—L. D. M.

The Shipshape Home

Many Uses for Linoleum

Discarded pieces of linoleum can be put to many uses in keeping a home shipshape. Kitchen and other tables with worn and cracked tops may be reconditioned by covering them with linoleum. If painted, varnished or shellacked, the linoleum makes a smooth, durable top.

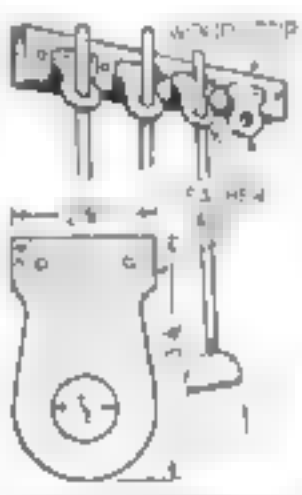


Besides serving for various repairs, old linoleum can be made into useful baskets

Chair seats may be renewed with linoleum. It will serve for backing shelves and picture frames. Disks cut from linoleum serve nicely for hot and cold platters, dishes and flower pots. Shoe insoles can be made from thin linoleum. Waste paper and sewing baskets may be made by the methods illustrated. Clarence D. Hugo.

Rubber Holder for Brooms

Small pieces of machine belting cut as shown and mounted on a strip of wood 4 or 5 in. apart are excellent holders for brooms and handled dusters. The board may be fastened to the wall in a closet or other convenient place. Care should be taken to have the holes fit the handles easily without being too large. A broom can be taken down from this hanger or replaced with a quick motion of one hand.



How the holders are made and mounted

In place of machine belting, the top of an old rubber boot or a piece of rubber tire, if not too thick, may be cut up and used similarly.—W. B. Stannard, Jr.

Hanging Tile Wallpaper

When I undertook the hanging of varnished tile paper in our kitchen recently I found it much more difficult than hanging ordinary wall paper. A decorator gave me a hint that enabled me to finish the job without further trouble. The thing to do, he said, was to have the paste a little thicker than usual and paste two or three strips before hanging the first one. In that way plenty of time was allowed for the paper to soften uniformly under the influence of the paste.—C. L. K.

How to Refinish Your Floors

(Continued from page 87)

has been treated with the caustic. Now make up fresh warm water and enough vinegar to turn the water sour, perhaps three pints of vinegar to a pail of water, and use this to mop the floor a second time to neutralize any caustic remaining on the wood or in the joints.

When the floor has dried overnight with heat in the room, it should be sanded smooth with a weighted floor brush faced with No. 1 sandpaper. Be sure to sand in straight lines parallel to the joints. If any spots remain, they may be sanded or bleached out.

The second method necessitates the use of varnish remover. The can should be shaken before it is opened for use since varnish remover consists of powerful solvents combined with a solution of paraffin wax. When this mixture is properly applied to the floor, the paraffin forms a blanket over the solvents and prevents their too rapid evaporation and at the same time forces them downward to attack the old varnish. It should be flowed on from a wet brush through the use of a single stroke drawn in one direction only.

Allow the remover about three minutes to soften the old finish. Then scrape the varnish off with a wide bladed scraper and place the softened varnish waste on scrap paper, which should be thrown into the stove and burnt.

DO NOT apply varnish remover carelessly on a floor having an electric floor plug, as short circuits have been known to cause disastrous fires. Be sure to cut out the main switch while doing work on such a floor. Use great caution around the floor plug to make sure that no remover gets in to cause a short circuit when the switch is closed again.

Stubborn spots can be forced by rubbing with No. 3 steel wool. When a part about ten boards wide has been stripped, it should be washed clean with denatured alcohol and burlap bagging. Allow the floor to dry overnight before sanding.

Both types of floors, either machine or hand cleaned, are now ready for the second process that of applying the filler or stain. Today our educated sense of color balance demands an orderly movement in color values from the ceiling to side wall to furniture to floor in which case the latter is, of course, the darkest. Thus, if we have a ceiling not quite white, side wall ivory, furniture walnut or mahogany, the floor should be, from an artistic standpoint, a deep brown to support this color mass. With this thought in mind we can make up our filler to a deep walnut color or buy it ready made, as the case may be.

If you prefer light floors—and they are, of course, still very popular, as they are generally believed to be easier to keep looking well than dark floors—you will, of course, use a natural colored filler.

A good filler is made on a silex base, not on cornstarch or whiting. Cornstarch shrinks in the pores and hence will not produce a satisfactory base for the finish. Silex or silica, on the other hand, is made from ground flint or quartz and is unchangeable, while having the additional value of being transparent.

Let us make up a liquid of three quarts of benzene or gasoline and one quart of real turpentine. To this we add eight or ten pounds of silex and stir to a milklike consistency. In order to bind this mixture together, we will add one quart of floor varnish, one pint of boiled linseed oil, and one pint of japan drier; this is to make the filler harden quickly and evenly.

Up to this point we have introduced no color and hence it may be used to fill the floor and produce the so-called natural or light finish. Suppose we have decided in this case to make it a deep walnut. It will be necessary to add a pint of asphaltum varnish to give the filler a deep golden tone, and then stir into the pail of filler mixture three pounds of burnt umber and one pound of Vandyke brown, ground in japan or in oil, the former preferred. When all is mixed thoroughly, it is well to strain it through a layer of coarse burlap or bagging to be sure none of the japan color has remained in lump form.

Before starting to fill the floor, it will be necessary to get some old bags and cut them up into 1-ft. squares. A few clean rags also will be needed.

Start in a corner of the room and, taking a strip about five boards wide clear across the room, brush the filler freely with a wide stubby brush, too worn for good painting. Now fold some burlap squares into a smooth pad and rub the filler vigorously into the pores and joints across the grain. The same pad should be used for all the work of "pushing in" as the face of the burlap becomes loaded with excess filler and so hastens levering the pores and floor joints with solid material. An excess always remains, however, which should be cleaned off with fresh burlap and rags.

YOU will appreciate the fact now that floor work means quite a bit of real labor, and when it comes to applying the filler and perhaps the cleaning up of the floor in the beginning, I would suggest the hiring of a painter accustomed to this kind of work. However, the task should not daunt any thoroughly enthusiastic home worker; it merely calls for vigor and persistence.

At this point in our discussion, I want to be quite emphatic on the amount of time to be allowed for the filler to dry. Under no circumstances should less than twenty-four hours be allowed for drying, and forty-eight are better. The room should be kept warm and freely ventilated in the meantime.

From this point on we have several choices of finishes available.

Next month Mr. Waring will tell in detail how to finish floors with shellac and wax, varnish, and brushing lacquer.

A Kitchen Table Bench

(Continued from page 75)

Fig. 5. A homemade wooden stop for planing

bone and effort will produce a more satisfactory stop as shown in Fig. 5. This stop is made from three pieces of hardwood ¾ by 1¾ by 6 in. One edge of each of the two wedge-shaped pieces is beveled to prevent the clamping piece from rising when pressure is applied. If enough taper is put on the pieces, the stop will grip stock varying in thickness from ¼ to 1½ in.

Many a home worker undoubtedly will wish to increase the possibilities of this outfit by using a metal stop and a small metal vise. Both of these usually may be obtained at the hardware store. If not, they can be had on special order.

THERE are several excellent types of stops available, but the kind that is adjusted with a screw driver is preferred by many because it stays "put." To fit in such a stop, first bore a hole large enough to allow the bar to move freely. Then place the stop in position and mark around the horizontal surface with a knife or awl. The cutting is completed with a chisel until the top of the plate lies flush with the bench top. The stop is fastened with screws as illustrated in Fig. 6.

The reciprocating type of vise probably is preferable for a small bench. It may be only 4 in. in length but one with 6-in. jaws will prove more satisfactory in the long run.

These vises are made for tops of 2½ in. in thickness, so for this job it is necessary to build up the thickness by using a ¾-in. piece of wood as a filler.

Fig. 6. Fastening an iron stop in place

To fit the vise in place, turn the plank over as shown in Fig. 7. Detach the free jaw of the vise temporarily for convenience in working, then fit the stationary part to the top. Cut back in the edge of the top for the thickness of the jaw and also make allowance for screwing a thin piece of wood to each of the inside surfaces of the jaws to prevent marring the work.

If an "apron" piece is to be used to hold up long boards as shown in Figs. 1 and 8, the thickness of it must be taken into account so that it will come flush with the jaw of the vise. Such an apron can be nailed to the edge of the plank or under the edge, according to the construction desired.

Continued on page 107

A Kitchen Table Bench

(Continued from page 101)

upon; the former is the easier method.

A substitute for a vise that is sometimes used is a block about 1¾ by 3 by 8 in., which is cut on a long bevel for 3 or 4 in. on one of the flat faces and screwed against the upper left-hand corner of the apron in such a way that the beveled part forms a V-notch into which one end of a board may be pushed when it is to be planed. The board is further supported by two pins inserted into holes in the apron.

Fig. 7. How a rapid-acting vise is fitted

When thin stock is to be planed on the surface and you have not fitted a regulation bench stop, you can nail a strip of wood temporarily across the face of the bench board to act as a stop. If you prefer, you can make a removable stop by nailing or screwing a block ¾ by 1½ by 4 in. across one end of a thin piece of hardwood ¾ by 4 by 12 in. To use this stop, the block at the end is gripped in the vise in such a way that the thin board lies flat across the bench top.

To do smooth surface planing, it is important that the table be rigid. It can be braced by cutting a stick of wood to reach diagonally from under the left end of the bench top to the juncture of the floor and wall of the kitchen or to any

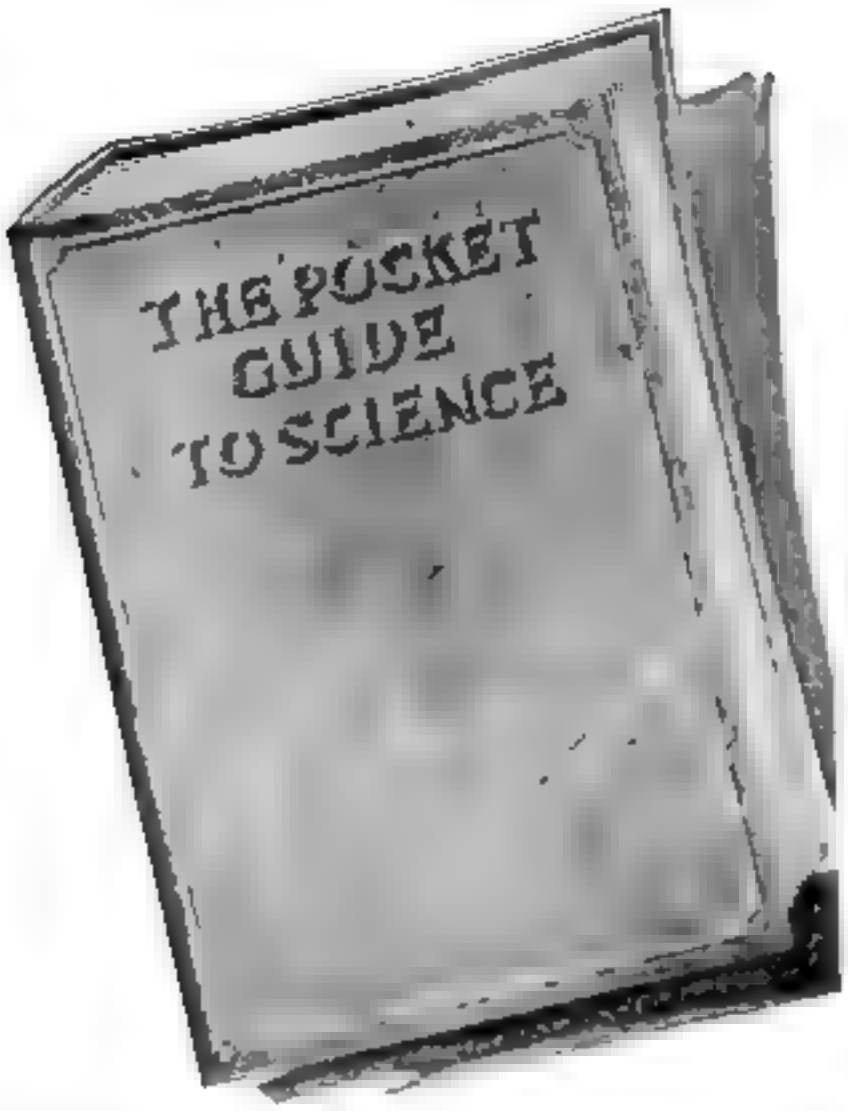
Fig. 8. One form of bench top with apron, quick-acting vise, and adjustable planing stop

convenient stop on the floor. This brace will resist the tendency of the table to sway when the plane is pushed forward.

Because of the bulkiness for storage, it may be better in some cases to omit the apron and use instead a special support constructed like an old-fashioned window stick, having a number of notches to suit boards of various widths.

The completed top with metal stop and vise and with an apron containing a series of holes for supporting long boards is shown in Figs. 1 and 8. With such a convenience the handy man is not prohibited from doing small jobs in repair and construction even though modern civilization has forced him into restricted quarters in which to work.

Next month a bench lathe table for small quarters will be described.



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What is the source of sunshine?
What is the [illegible] on the liver?
Why are [illegible]
[illegible]
Why is [illegible] so much harder than it is to smoother than steel
How do all wireless [illegible] work?
Why does an [illegible]
Can we see a germ with a microscope?
What are [illegible]
Is electricity a form of matter?
What [illegible]
How large is the universe?
Why do [illegible]
How do we know what the stars are made of?
Is the inside of the earth molten?
Why [illegible]
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P. P. 5-27

Graceful Gate-Leg Tables

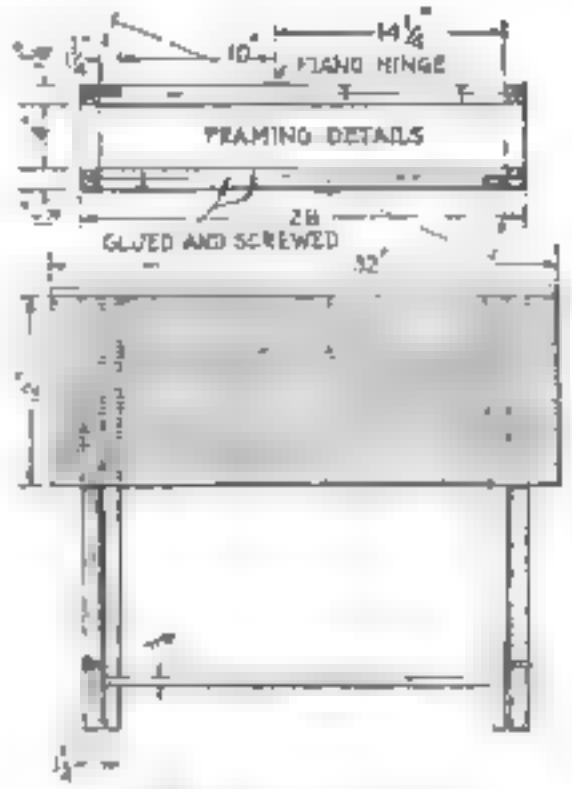
(Continued from page [illegible])

although it is quite simple, adds very much to the beauty of the table. Almost any cabinet wood will be suitable. A dull dark finish is recommended although colored, brushing lacquer or enamel may be used on the simpler table.

Bill of Materials

No. Pcs.	T	W	L	Part
				For Figs. 1-2
				Top
				Legs
				Rail
				[illegible]
				For Figs. 3-4
				Top
				Legs
				[illegible]
				[illegible]
				Rail
				[illegible]
				Moulding
				[illegible]
				Stretcher

All dimensions are in inches



SIDE VIEW OF TABLE CLOSED

Fig. 5. Another view of the table showing the gate closed. Detail of the framing

How to Repair Chair Seats

[illegible]

CANING, in our April, 1925, and rushing in our November, 1924, issue. A few copies are available at 25 cents each.

Small Vise Provides Feed for Drilling

By Owen Lovejoy

HOLES of varying size can be drilled through stock up to 1¼ in. in thickness with the inexpensive drilling device illustrated.

The machine is an inexpensive polishing head driven by an old vacuum cleaner motor, the main uses of which have been described previously in Popular Science Monthly.

The main feature of the drilling attachment is the feed, which is provided by a small vise clamped to a wooden upright. The shank or bar of the adjustable jaw of the vise serves as a support for the piece to be drilled. The drill point enters the hollow end of the shank after it has passed through the work.

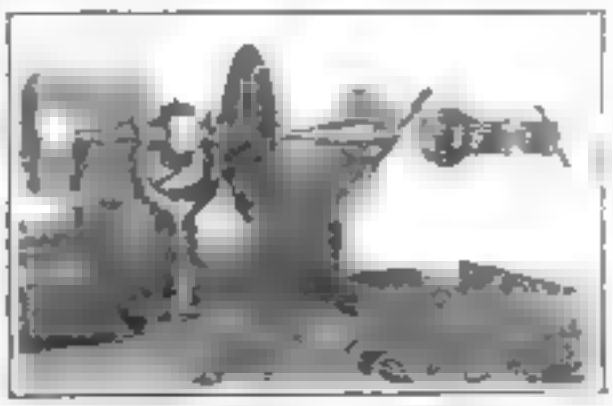
It was necessary to saw off the anvil nose of the vise with a hack saw, but otherwise the vise is strong and may be taken off at any time and put to its ordinary uses. The wooden support post may be removed quickly to clear the bench for other work.

Several sets of screw holes in the top of the bench allow the wooden upright to be set closer to or farther away from the polishing head to suit various lengths of drill bits.

The drill chuck shown is an improvement over a similar one illustrated in a previous article. A piece of broomstick was drilled and screwed on to the taper spindle of the polishing head and then turned until a 3-in. length of iron pipe could be driven on over it. A taper hole next was turned in the outer end of the wood so that the shank of a bitstock type of drill could be driven in. Any size bit from ⅛ to ½ in., or even more, may be used.

To remove a bit from this improvised chuck, it is grasped by a heavy pair of pliers, which is then struck a sharp blow. The bit is inserted in the same way.

Before a hole is drilled, a center mark is made in the work with a sharp punch.



How Mr. Lovejoy uses a polishing head and a small vise on a drilling machine

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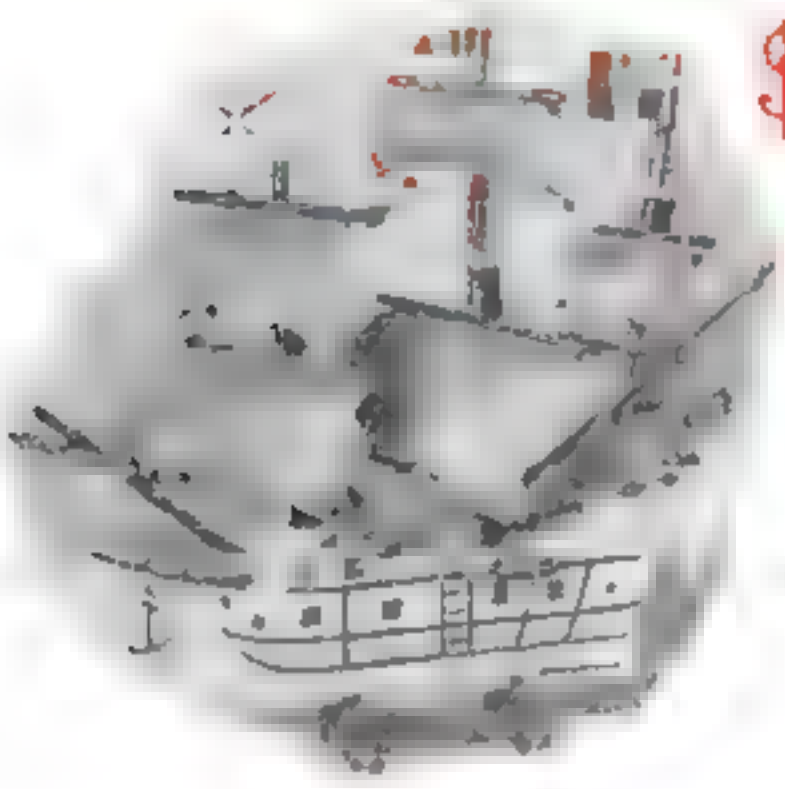

No tool needed but a small tack hammer

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Size: Height 25", Width 9", Length 27"

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The Flag Ship of Columbus in the Discovery of America in 1492
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List of parts supplied for "Santa Maria." Space does not permit describing the parts for "Mayflower," but it is just as complete in every detail

Hull and keel, 3 pieces, rudder; rudder support, 6 hause pipe rings, 6 cannons, 6 port shutters, 11 shields, front and poop deck sides, railings; upper deck with decorated stern, rigging channels, anchor, lamp and bracket, crow's nest, bow sprit; yard arm; 3 masts, fore, main and mizzen; spanker boom, pb yard arm, fore mast yard arm, main sail yard arm; top sail yard arm and lateen sail yard arm, wire for sails, brass name plate, rigging cord light and heavy, beads staples, glue pulleys or blocks and sails, rear balcony, rear balcony railings, side balconies, side cabins, flags, ladders, 18 bumping strips, pb sail, fore sail, top sail and mizzen sail, stand, 3 pieces; all parts needed to complete the Model. Shipping weight, 6 pounds. All Canadian or Foreign orders must be accompanied by Money Order for $4.98, plus a sufficient amount for parcel post charges.

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A Stand for Shoe Polishing

Has Convenient Foot Rest and Compartment for Cleaning Materials, Brushes and Cloths

By William W. Kleske
Woodworking Instructor, Central High School, Newark, N. J.

"WHAT is the trouble, Frank?" I asked, as he strolled into the school shop with a downcast face.

"I was called down at drill inspection on the gym for not having my shoes polished," he replied.

"Well, that suggests a good idea for your next model—a shoe polishing stand."

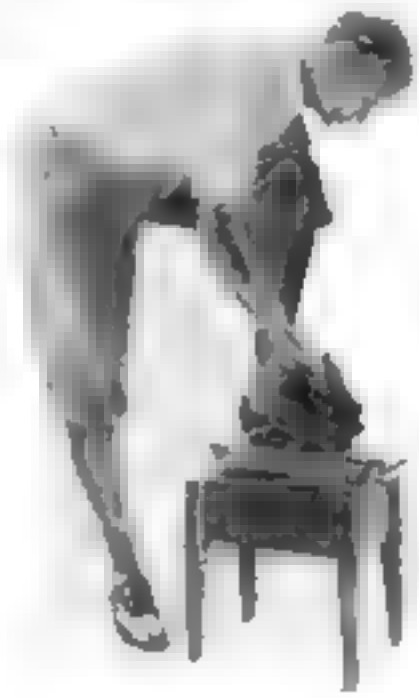
"That's fine!" exclaimed Frank, brightening up. "I'll start in today, if it is convenient."

I gave him a drawing similar to that reproduced below and told him to get out the rough stock using whatever I had. Frank soon had this done.

"Lay out and plane the taper on the four legs," I said, "but remember to taper only two sides of each leg. After you have planed the legs, hand dress the rails and plough out the rabbet on the underside of all rails to receive the batten board."

Frank finished this before the close of school and came in early the next day.

"Why, you are one step ahead of me," I told him. "I see you have sandpapered the legs and rails. Now for the joints. This joint is called a leg and rail or butt dowel joint and is very simple to make if you follow instructions. First mark each leg and rail with a number, one and two, three and four, and so on, to indicate which leg and rail are to be glued together. Then, with a marking gage, draw the center lines on both legs and rails, being careful to set the gage one quarter inch greater for the legs. That is to take up the setback of the rails. The next step is to place each leg and the corresponding rail (as one and two) in the vise and with a try square and knife intersect the gaged center line, thereby marking the centers of the dowels. Using a three-eighth-inch auger bit, bore holes three quarters of an inch deep at each point.

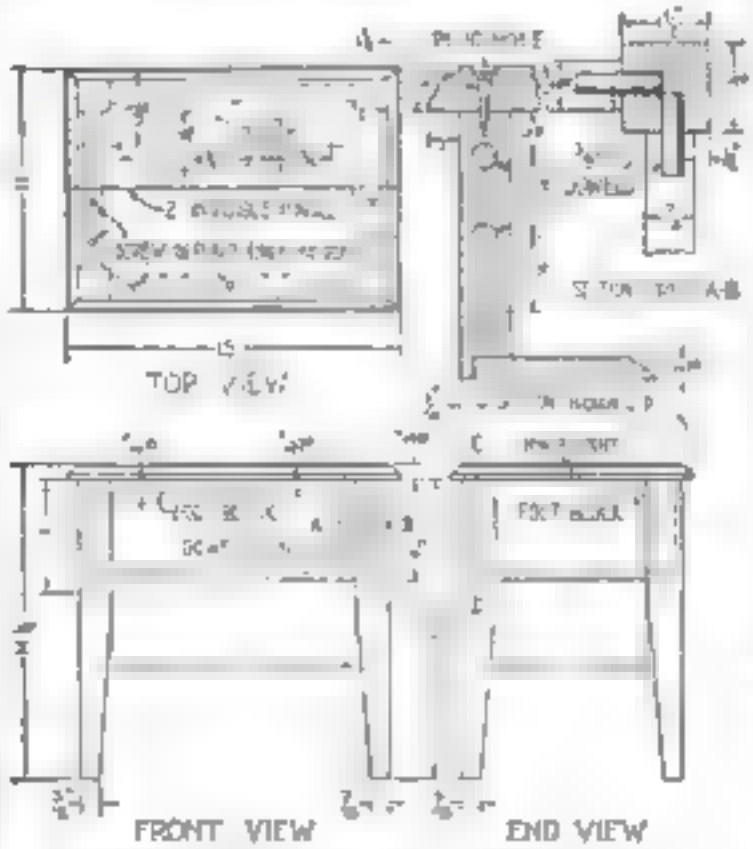


A handy stand like this makes the polishing of shoes less disagreeable

"That means twelve cutting turns, doesn't it?" interrupted Frank.

"That's right. The fourth step is to place a long dowel rod in the vise in a vertical position and use a dowel pointer and brace to chamfer the end slightly. Move the rod up in the vise and saw off a piece one and a half inches long. Repeat until all the dowel pins have been cut. Notice that each dowel pin will be chamfered on one end only. When inserting these pins into their proper holes, place the square end in."

"Why not countersink the holes instead of chamfering the dowel pins?" Frank inquired.



How the stand is constructed. The edges of the top may be molded as shown, rounded, or left square

"THAT would accomplish the same thing—that is, to make it easier for the dowel pins to enter the holes when the parts are forced together. The fifth step is to drive all pins in place (square ends first) and make a trial fitting by clamping the entire job—of course, without glue."

Frank made his trial fitting and then struggled to pull out the dowel pins.

"Try a pair of gas pliers," I suggested, "but do not remove them all the way—just enough so that the fingers can do the rest. When gluing up any furniture, it usually must be done in two separate operations with at least eight hours between for the glue to get hard. On

Continued on page 197

Stand for Shoe Polishing

(Continued from page 166)

this piece it makes no difference whether you start with the sides or the ends. Suppose we start with the ends. Put plenty of hot glue in the holes and also dip the unchamfered ends of the dowels halfway in glue; now drive the dowels into the ends with a mallet. Put plenty of glue on the rest of the pins, also in the opposite holes. You will have to hustle at this point or the glue will set too much before we have the joint clamped up tight. Now 'quick' the clamps!"

"Here are scrap pieces of wood, too," Frank said. They were to prevent the clamps from bruising the wood.

Sight across both legs to make sure they are in line," I told him, "and remember to throw a little sawdust on the joints when they are together; that will make it easier to remove the glue

IT WASN'T long before Frank had both ends glued up. "What a next?" he asked eagerly

While you are waiting for the glue to set, we can finish the top. Hand dress both surfaces and carefully jack (plane) the edges. Lay out for the invisible hinges, locating the centers for the screws, which will also be the centers for boring the holes to receive the hinges. It is worth while to try it out on scrap stock first, Frank, as you have never used this type of hinge before. If you ever want to use this type of hinge in work at home you will find you can get them at any well stocked hardware store."

After a short time Frank came over to me with a satisfied smile swinging the cover back and forth to show me that the hinges did not bind.

"Now for the foot block," I told him. "You will find it easier if you will cut out the outline, glue it to the cover, then shape it with a flat gouge and spokeshave. Then fasten the top to the body part and nail the bottom in place."

That done, Frank sandpapered the stand with No. 1, No. 0 and finally No. 00 sandpaper. He took pains to use the paper folded over a block of wood

"I WOULD like to finish this a walnut color," was his next remark

"Then apply a coat of either walnut oil stain or penetrating brown oak stain," I said. "I prefer as a general rule to use the penetrating stain on whitewood. After you have applied the stain, wipe off the surplus with a piece of cotton waste or a rag and allow it to dry overnight. Apply four coats of white shellac—the first coat very thin—and rub between coats lightly with number 00 sandpaper. Rub the final coat thoroughly with number 00 steel wool. Of course, you remember that we must allow time between coats for the shellac to harden. Then apply a coat of prepared polishing wax—floor wax."

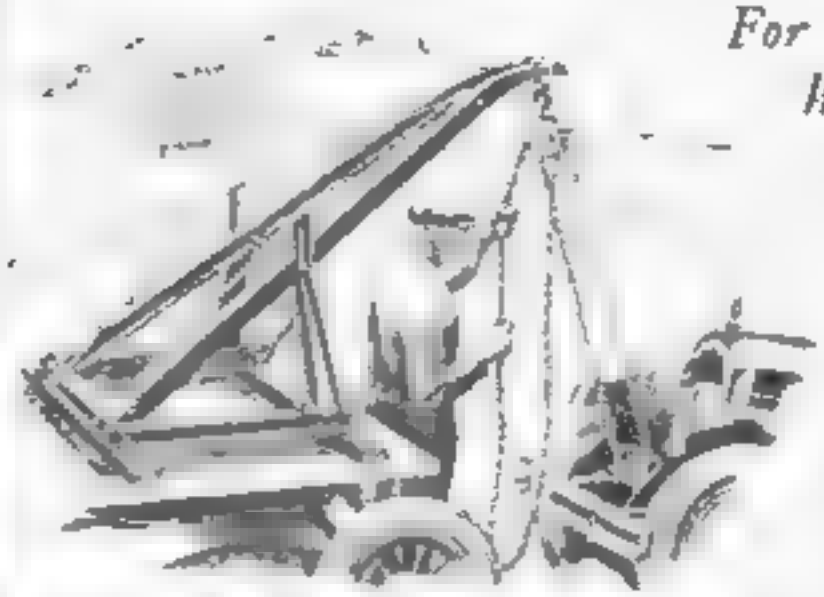
A few days later Frank gave a brisk final polish to the job.

"If you will use a little of the same elbow grease when you polish your shoes," I told him, "your shoes will be sure to pass inspection."

Crane Built at Low Cost

For Use on Emergency Wrecking Car of Small Garage

By George H. Capple



The frames of junked autos provide most of the material for this light wrecking crane, designed for garage use

SOME kind of a wrecking crane is almost a necessity in every commercial garage, large or small. Many establishments are able to purchase one of the rather elaborate cranes on the market, which, when mounted on a well-painted truck, makes a good moving advertisement of the garage.

The smaller garage man frequently contents himself with a wrecking car made from an old passenger vehicle, or sometimes a truck, without the advantage of a crane. With the equipment in the garage and material from scrapped frames, a mechanic can build a highly satisfactory crane for handling wrecked cars on the road or for use in the shop.

The hoist mechanism is a one-ton differential chain block. This is the least expensive type, and one is probably in use in the garage already. The main members of the crane, marked A in the drawing, are from the frame of a junked car. It is, of course, essential to have them heavy, the heavier the better. They are supported by other frame sections cut and formed as shown and cross braced with ⅜ by 2 in. flat iron.

THE longitudinal frame members, marked C in the drawing, are attached to two other sections of old frame, E, making the entire crane self-contained so that it can be attached to the truck with four bolts in a short time, and removed when not needed.

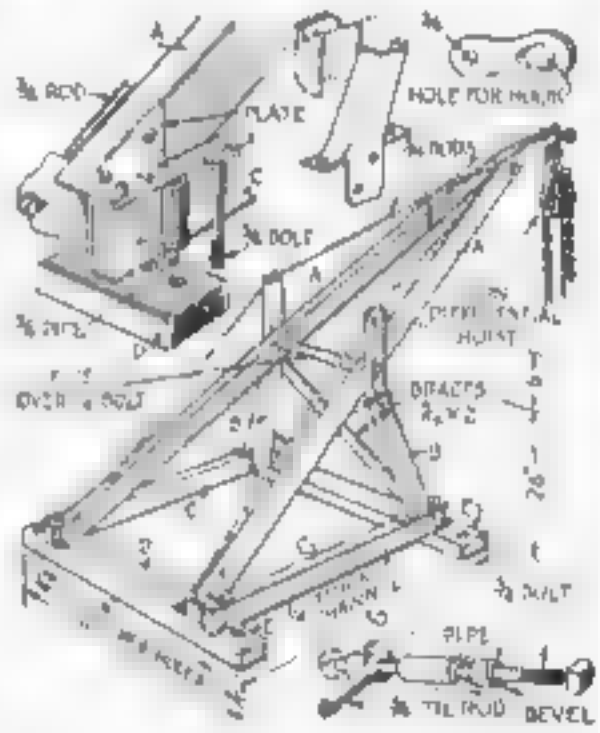
The inclined members A should be of such a length that the crane has an overhang of about 42 in., measured horizontally. It is well to lay out the parts on the floor before cutting or bending any of them in order to make best use of the material and insure suitable proportions.

Two ⅞ in. rods are used to strengthen the inclined members. These can be attached with the same bolt that holds the link for the chain block, or a short distance below. They are passed through a cross piece, D, at the bottom, which is attached to the longitudinal members.

The cross members E are fitted with hardwood filler pieces. The longitudinal members are bolted to them with ½ in. bolts, with a short length of pipe between the flanges to prevent distortion. These cross members should be about 32 in. long, and if the crane is to be used on a Ford truck, holes should be drilled on 28 ½ in. centers for bolting to the truck frame.

The inclined members are attached to the pieces B by means of a ¾ in. rod passed across, with a pipe over the rod so that it can be drawn up tight with nuts.

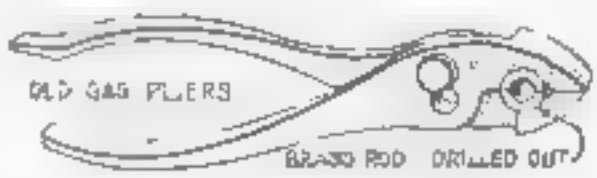
Riveted connections should be made with ½ in. rivets driven hot. Welding will be useful if done by a skilled welder.



How the crane is made, and suitable dimensions if it is to be mounted on a light truck

Gripping Small Polished Rods

WHEN work must be done on small polished rods, special care is necessary to prevent marring the finish.



Special pliers with brass lined jaws

The pliers illustrated were prepared in one shop to aid in screwing nickel plated rods into place. An inexpensive pair of gas pliers was ground out and filled with brass welding rod as shown; then a hole was drilled to fit the work.—W. S. M.

Corner China Cabinet

Continued from page 81

immerse the piece in hot water for about fifteen minutes. Then fasten it on with fine brads after mitering the corners to join neatly with the corresponding molding at the sides.

The curved drawer front may be sawed easily on a band saw machine. Make a pattern by placing a piece of heavy paper over the edge of the lower shelf and press around the corner with the fingers. Take this pattern to any woodworking mill and have the drawer front, which is to be 3¼ in. wide when finished, cut from a piece of stock about 4 by 9 in. Have the piece run over a sander after being sawed.

This should be fitted carefully to the opening, leaving about ⅛ in. for clearance. The sides and bottom of the drawer are made of ¼-in. stock. The front is rabbeted as indicated to receive the sides. The front edge of the bottom is cut to the exact curve of the front and fastened with 1-in. wire brads, which are set in and the holes filled later. If preferred, a rabbet can be cut in the front piece to receive the bottom.

The partitions for separating the silver are of ¼-in. stock, fastened in place with brads through the front.

It is a good idea to line the inside of the drawer with some suitable cloth of a color to match the trimming.

In finishing the cabinet have it match other pieces in the breakfast set or make it French gray with blue trimmings on the face of the drawer knobs and a small blue flower design painted on the front edge of the top in the center. If this color scheme is followed, first give it two coats of flat white paint tinted gray with a small amount of drop black. Fill the nail holes after the first coat. When dry apply two coats of French gray enamel and add the blue trimming.

If it is desired to stand plates up on the shelves, grooves may be cut in them before assembling, either by hand or preferably, on a circular saw. The grooves should be 1¼ in. from the edges and not carried farther than within ¾ in. of the front edge.

Cleaning Paint Brushes

A PAINTER friend once gave me a simple tip about keeping brushes clean that has made my painting look much more professional.

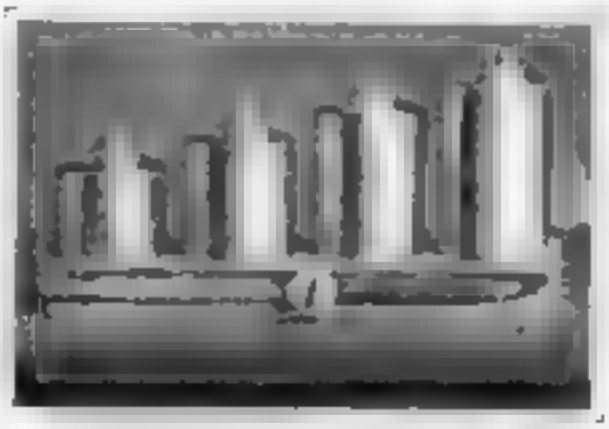
"Get some creosote," he said, "and soak your brushes in it. Then wash them thoroughly in gasoline, and they'll be really clean."

I bought a quart of creosote at a paint store and poured it in an empty coffee can so that the brushes could be left hanging in the solution until wanted. It is essential, of course, to wash out the creosote before putting the brush in paint.

As an experiment, I placed several old brushes in the creosote, and left them for several weeks. The creosote finally ate off all the dried paint, clear down to the wood and metal of the handle. By alternately washing them in gasoline and rubbing on wood, I cleaned even the interior of the brushes.—O. H. K.

Toolmaker's Buttons Used As "Mike" Checks

IN THE illustration below is shown a two-in-one tool—a set of toolmaker's buttons that serves also as a set of "mike" checks. The diameter of the buttons is .500 in. and lengths are .750, .625, .500, and .375 in. respectively



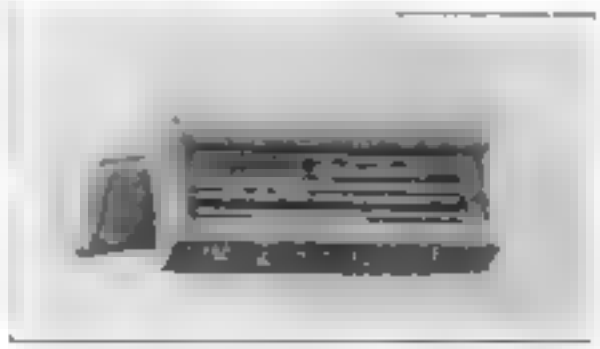
A combination set of toolmaker's buttons and "mike" checks, with the tap and drill

They are hardened, ground and lapped all over. Their different length makes them convenient for many layout jobs. As "mike" checks they afford a range from ½ to 1 in., by eighths.

The screws have a No. 0-32 thread. A slot is cut on each side of the holding plate to receive the drill and the tap.—H. J. C.

How I Make Small Tap Boxes Last a Long Time

SMALL wooden tap boxes are at best fragile affairs. On becoming oil-soaked or damp, the light finger-joint corners pull out and loosen quickly. Taps are then easily lost on the road or



The interlocking box joints are reinforced by ordinary pins driven through them

misplaced when kept in other containers around the bench.

I drive or force a small brass pin through the interlocking tenons at each corner of the box, cutting the pointed end off smoothly. Tap boxes will last a good many years after this little addition has been made to them. Pins are cheap, but taps cost money.—F. W. B.

SCREW DRIVERS with broken handles or damaged blades are dangerous to use. A surprising number of accidents are caused by them and, indeed, a good many mishaps occur through the use of screw drivers which do not fit the slots of the screws which they are expected to turn. A screw driver blade for general use is tempered and drawn to a light blue. It must be ground cautiously, otherwise it will be made too soft by overheating.

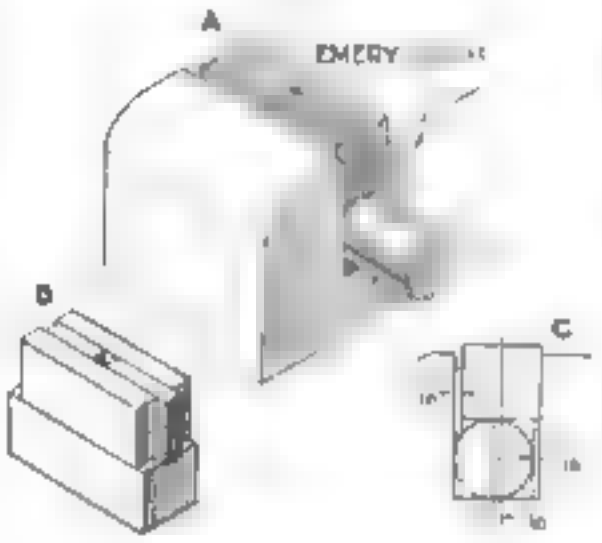
This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Tricks to Help You Drill Round Stock

IN THE illustration below is shown a simple yet accurate way of drilling a central hole transversely through round stock. It is equally applicable to plain and threaded work and can be used in any shop. So little time is required for the necessary preparations that it will often pay to use the method even for drilling a single piece.

All that is necessary is a square vise and a short block of square, cold rolled steel of a size corresponding to the outside diameter of the work to be drilled. A hole is first drilled as nearly as possible through the center of the square piece. This is placed on top of the work in the vise as at A. Between these and the movable jaw of the vise is inserted a strip of emery cloth, turned with the plain side against the two pieces.

When a greater degree of precision is required, an easy method of drilling the



Simple jig block (A), built up jig (B), and a method of drilling stock off center (C)

piece is that shown at B. Assuming, for instance, that the lower block is of 1-in. stock and that a ¾-in. hole is to be drilled through it, a temporary jig is built up from two pieces of ½-in. flat stock separated by two pieces of ¾ in. The two inner pieces are shoved lightly against the drill just before the vise is set up, thus forming a hole ¾ in. square, which will be central within a thousandth or two. From this temporary jig the work can either be drilled directly, or, where a number of pieces have to be handled, a solid jig block produced.

By drilling several holes of different sizes in the same block and hardening it, the jig will be rendered well worth preserving for future use. As square stock differing by sixteenths is readily available, it is usually feasible to match round work of standard size. Work of odd diameter can be handled by shimming either the work or the jig block equally from both sides.

By a modification of the same method, work can be drilled off center. At C is shown how a piece is drilled ⅛ in. out of center by placing a ⅛-in. shim on one side of the work, and a similar shim on the opposite side of the jig block.—H. S.

Hints on Lathe Tools

(Continued from page 85)

"Why would you have such a blunt nose to the tool?" asked Harvey. 'You have so little clearance that I should think the tool would cut hard.'

"Not at all. A fine-pointed tool heats up much faster than a blunt one, for as the point of the tool develops the most heat, so the greater the amount of metal near the point, the cooler it will remain because the heat is absorbed. You know that when you grind a fine-pointed tool, you have to be careful not to burn it for the same reason.

'I see what you mean," said Harvey, "but why wouldn't a round nose tool be good also? Nobody ever uses a round nose for roughing out steel, yet it is blunt and would carry away the heat.'

"YES, but the cutting action of a round nose tool isn't right for steel. It takes too big a chip and too much power. It really isn't as good as some others for cast iron, although many machinists use it. Look at this tool (A in Fig. 4) and see what a lot of surface it touches. Then look at B and see the difference in the arc of the contact with the work. Of course, for combination facing and turning cuts as at C, a round nose can be used to advantage because it will cut in either the direction D or E."

"What about the position of the tools —above center or below?" was Harvey's next question.

"You ought to be able to answer that yourself. Here's a tool (A in Fig. 5) set above center, and here is another (B) on center. C is below center. Which is best?"

Harvey looked at the sketches.

"Why C, of course," he replied, "or B, but never A, for that would dig."

"Yes, you're right, Harvey, but the tool should be only a trifle below center to get good results. Now, let's go back to tools for steel and talk about the angle of shear. Look at this sketch (Fig. 6). The sectional view A shows the working part of the tool against the work. In grinding the tool for steel, the angle B should be between fifteen and twenty degrees and clearance angle five to eight degrees. The other slope C should not be too great—about seven or eight degrees for mild steel. It is a good thing to keep the angles approximately right. Too much angle is worse than too little because the tool will not stand up and also it tends to dig in under the pressure."

"WHAT about turning tools for brass? We are getting a lot of brass work just now. I generally grind a tool about the same as for cast iron."

"That is usually quite satisfactory for brass castings, but for soft bar brass, a little lip angle is an improvement and will give you a smoother job. You know, of course, that tools used for brass should be stoned frequently to keep the cutting edge keen.

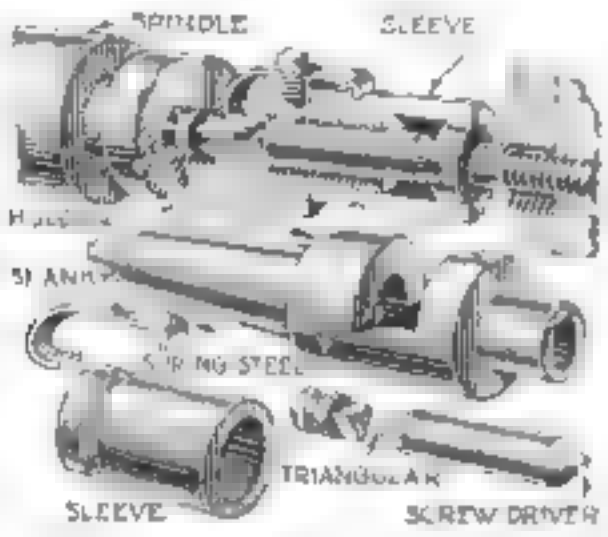
By the way, Harvey, I noticed that you have several boxes of aluminum castings to be machined on the turret lathe. I suggest you draw off some of the lard oil in the machine and put three or four gallons of kerosene. (Continued on page 113

Power-Driven Screw Driver for Small Work

ELECTRICAL shops or machine shops assembling relatively small parts in quantities, will find the tool illustrated convenient for driving screws. It can be used either in a speed lathe or on a drill press.

There is a holder of machine steel with a taper shank to fit the machine upon which the tool is to be used. Over this is a sleeve which fits loosely the outside of the screw heads. Several sleeves can be made to take screws of different sizes.

Within the body of the holder is the screw driver proper. This should be made



A broken-away view of the screw driver in use and the parts of which it is made

of tool steel and tempered. The point is formed to the shape of a screw driver blade, while the upper portion is made triangular as shown to provide for release when the screw is driven home. There is a groove in the upper end to receive a retaining pin.

A rather heavy steel spring engages the flats on the triangular portion of the driver and at the same time holds the sleeve in place. When the screw is tight the spring slips over the corners of the triangular portion. This spring is fastened to the body of the holder with a small cap screw.

In operating the tool the screw may be placed in the driver and then started in the hole or the screw may be started by hand and the driver brought up to it.—G. A. Loomis.

Hints on Lathe Tools

(Continued from page 111)

in its place. That will make a good cutting lubricant for aluminum work. Do you know how to grind tools for aluminum?"

"About the same as for brass?"

"No, indeed," said Grimes. "They should have a lip as much as for steel, sometimes even more, if the alloy is very soft. Tools ground as for brass are likely to tear the metal and give a rough surface. You often have to experiment with different angles on account of the difference in aluminum alloys. You had better keep that in mind when setting up machines for those jobs."

"I'll keep all these points in mind," promised Harvey as he thanked the engineer and said good night.

Sling Steadies Steel Beams for Punching

IN A Denver steel shop, standard 8 in. channels, which are to be punched for rivets, are balanced in a sling made as shown. Two hooks 10 in. long are used and over these a short section of 2 by ½ in. bar, with a hole near each end, is slipped.

With a man at one end to steady them,

Punching rivet holes in a steel channel, which is balanced in a shop-made sling

the beams are carried easily by the overhead crane to the motor-driven punch, and held up while the holes are being made.

To control the channels beneath the punch, an iron rod 18 in. long, bent back at the end, is used. This fits firmly over the flange.—J. C.

Sheet of Glass Keeps Thread Tool and Gage Aligned

ALTHOUGH it may seem that a piece of ordinary window or plate glass would be of little value in a machine shop, it will be found a useful "tool" for certain purposes, especially in testing work.

When grinding a thread-cutting tool for instance the machinist compares the angle with a notch in a center gage by holding it up to the light and if the center gage is tilted slightly when testing the tool the angle formed will be incorrect, with the result that a perfect thread will not be cut. A better way is to place the center gage and the tool on a piece of glass for comparison, as illustrated. In this way, they are held in alignment with each other, and the angle on the tool will be correct.

Gage and tool rest against the glass

The same method may be followed when making templets, or when fitting the outlines of two flat irregularly shaped pieces. R. H. HARPER.

FOR HARDENING or tempering small parts in quantity, especially for so-called local hardening, a lead bath is excellent.

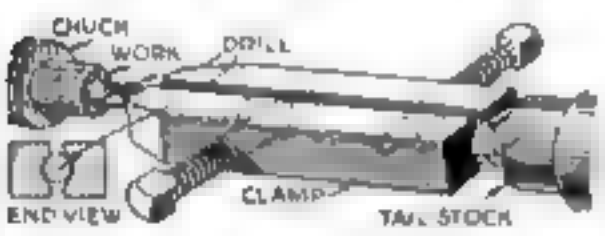
Extension Handle for Inside Caliper

IN ORDER that long holes might be measured with more certainty the writer made a handle for his inside caliper as shown in the accompanying illustration. It is of sheet iron and may be readily detached from the caliper.

Ordinary calipers with removable handle used for taking measurements in deep holes

A strip of sheet metal is bent back on itself and offset to go over the joint of the caliper. The holes in this simple handle fit around the bolt or rivet at the caliper joint. A tightening screw holds the handle in place.—H. Moore.

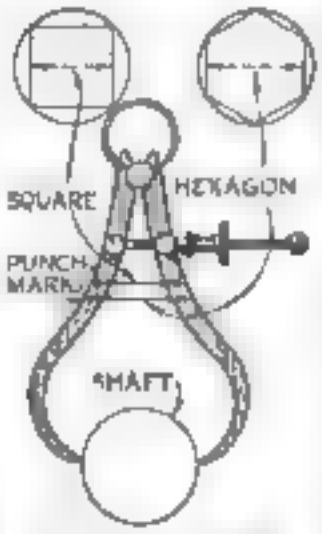
Substitute Drill Chuck



MACHINISTS sometimes are confronted with the necessity of holding a drill where no suitable drill chuck is available. In such a case an ordinary machinist's clamp, if provided with a groove, will serve satisfactorily to hold drills, countersinks, or reamers for the work.—G. L.

Specially Marked Caliper for the Stock Room

WHEN a requisition is made for a length of round stock of the proper diameter to allow an inscribed square or hexagon of given size to be finished within it, the stock room clerk can select a piece without any calculation if he provides himself with a specially marked caliper that gives the information automatically.



Caliper for choosing stock to be machined

Such a caliper can be made merely by placing two pairs of marks on the legs. One pair should be placed to show the distance across the flats of the largest hexagon and the other pair the distance between the sides of the largest square that can be machined from round stock of the size indicated at the points of the caliper.

LAUNDRY soap often will serve for stopping gasoline leaks in an emergency.

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Homemade Instrument for Perspective Drawings

A CENTROLINEAD is desirable in drafting rooms where numerous perspective drawings have to be prepared but it is a rather expensive instrument. To make one, however, is a relatively simple undertaking.

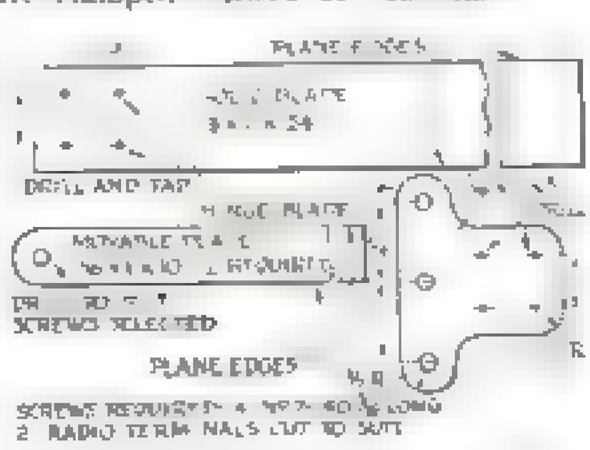
The instrument illustrated was made of celluloid such as is used for triangles. The long blade is 1/8 in. thick; the short movable blades and hinge plate are 1/16 in. thick. All three blades must be planed on the edges.

A good quality of hardwood may be used instead of celluloid. If you have a discarded T-square it may be cut down for the main blade.

How a perspective is drawn

Lay off the outline of the hinge plate as shown and locate the centers accurately for drilling. Follow the outline with a sharp knife, cutting a quarter through, then break like glass with the aid of pliers. Finish the edge with a file. The four small holes are to be drilled to take a No. 2-40 screw. Lay out corresponding holes on the blade and drill and tap for the screws. Screws of this size are often used on typewriters and may be obtained from a typewriter repair man. However a 1/16-in. standard screw may be substituted.

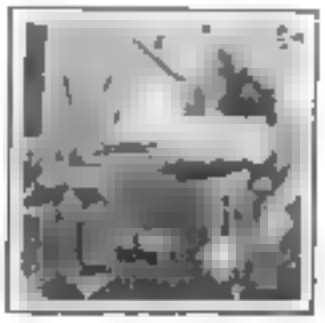
The swinging blades may be laid out and cut in the same way. The pivot holes are to be drilled a snug fit for the screw selected as a pivot and for the clamp screw. A radio terminal screw will work satisfactorily, the knurled rubber nut being used as a clamping nut. The screw must be cut off so that the nut will screw down to the head. A thin leather washer placed between blades and hinge plates helps to keep the blades rigid after they are clamped. —BOYD R. ALVORD.



The blades are celluloid or hardwood. A discarded T-square will make the main blade

Rubber Hose Extensions for Drill Handles

ELECTRIC hand drills, especially when used on heavy work and in different positions, have a tendency to jump out of a lone operator's hands if the drill happens to bind in the hole. In one shop a great aid in helping the workman to retain his grip was found in the form of two short sections of old hose slipped over the handles of the motor. These gave the operator a firm grip on the tool and enabled him to perform work that otherwise would have required a helper.—J. C. COYLE.



A good grip on an electric hand drill

When to Use an Oversize Drill Before Tapping

TWO electricians were drilling and tapping holes in structural steel for electrical conduit hangers. The screws were common No. 14-20 machine screws. One man used a $\frac{1}{4}$-in. tap drill (diameter .1875 in.), which is the size recommended in screw thread tables, and painstakingly tapped his holes with a tap held in a tap wrench.

The second man used a No. 3 drill (diameter .2130 in.) and, instead of using a tap wrench, put the tap in the chuck of his breast drill and ran it in and out very rapidly. This could be done because his holes were .0255 in. larger than those of his fellow workman and the tap was not required to cut a full thread.

From a theoretical point of view, the work done by the first man was preferable for it was more nearly perfect. From a practical standpoint, the work of the men was of equal value, for in both cases the screw heads would be broken off before the screw could be pulled from its hole. Viewed from the standpoint of efficiency, the work of the second man was far superior; by actual count he drilled and tapped approximately twice as many holes as his fellow workman in the same time.

When tapping screw threads in metal, the average mechanic, in his desire to do first class work, will follow exactly the sizes of tap drills given in the printed tables for the corresponding taps. This gives a commercially perfect thread, but the operation of tapping must be done carefully and slowly.

As applied to screw threads, it should be remembered that a perfect thread (full thread) is not always necessary and that a shallower thread will serve the purpose in many cases equally well. If the thread is sufficiently strong (that is, has sufficient metal in it) so that the screw will break under the strain before it will pull out, that is all that can be asked of any thread. This strength can be obtained with a shallow thread as well as with one of full depth, provided the screw makes enough turns in the hole.—V. A. LYMAN.

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Bare Hands

(Continued from page 56)

me when boat go smash. Him with I gashik go was in small boat. Him drown. Maybe I gashik too.

Parker had joined them and he carefully examined the footprints.

"There is no doubt about it," he announced. "Someone dragged him in here. Possibly it was this other chap—this what-s-his-name? I gashik? Likely it seems to me."

That theory calmed them some, all save Ohmak.

No, he objected. I gashik not do that. I gashik very fraid. No. Devil maybe. Not I gashik.

Once the body had been buried, the castaways pretended to regain their calm once more although they carefully stayed away from the grave.

They spent two days making their cave more habitable, and so effective were the new tools that they were able in that time to build a big wall, chinked with moss, before it, leaving an opening for the fireplace and one for a doorway that was closed by a crude door of woven willows.

THE lit "home" was really habitable now with beds made of saplings and small branches, covered with twigs, moss and grass. They had made a table of small split logs and along each side of it had built a bench, for they had hammered out a couple dozen nails from the scraps of iron left over after their tools had been made.

Not bad, what? asked Thornton of Williams, admiring his hard work after he had put finishing touches on the two benches. Almost as hard, I think. Now do you think we can build a boat?

Maybe, replied Williams.

Maybe the devil, grumbled Thornton. "It isn't a question of maybe. We have to.

"I'm not so worried about building the boat as I am about our getting away in it, explained Williams.

You mean

"Sails, interrupted Williams. "I don't believe we can do it.

"Could we row it?

"Not a chance in the world. It would be big and heavy, and we have three hundred miles to go—maybe more—against wind and current, and look at the weather we're getting now." He waved his hand toward the uninterrupted sea. "We'd all be exhausted in a few hours, and then we'd drift back as far as we had rowed. Doggone it! I wish we'd been wrecked with a gasoline engine and a few barrels of gasoline.

THORNTON looked out to where the wind was still whipping the tops off the waves.

"You might as well say that we hadn't been wrecked at all," he replied. "Or while you're wishing, just wish for a spare bit of canvas or two. But an engine—" He stopped abruptly and opened his eyes wide. "By George, I wonder."

"Wonder what?" asked Williams.

"Could we build an engine?"

"Build your grandmother!" scoffed Williams. "Where would you get the gasoline?"

"Gasoline nothing! I mean a steam engine," explained Thornton.

You couldn't do it.

Why not?

No tools.

We can make them.

How would you make the cylinder?

"Make cast iron and cast it.

How would you finish the inside?"

"On a lathe.

"Lathe, my hat! Where's your lathe?

"We can make one.

"Yes—and turn it with your foot, I suppose.

"No. We can build

Continued on page [illegible]

Bare Hands

(Continued from page 118)

a dam and a water wheel for the power."

Williams looked thoughtfully at his companion. "Do you really think we could?" he asked.

"By George, we can try," insisted Thornton.

"But look, the fence! It can't be done."

"Well, now, just what about it can't be done?"

"Cylinder, piston, piston rod, bearings. You can't make them."

"I can."

"Then how about your boiler?"

"We can make plates and rivet them together."

"The darned thing will explode."

"No. We would have to make two or three small boilers. They'd be stronger that way."

"How about steam pipes?"

Thornton hesitated.

"You can't do it," denied Williams.

"Yes, I can," insisted Thornton. "We can cast them of steel."

"How about bolts and screws?"

"We can use pins and rivets."

WILLIAMS stopped again and looked at his friend.

"Do you really believe we can?" he asked.

"I am sure of it," replied Thornton.

"Then I'm hanged if I won't help! Let's go!"

"Whoa, whoa!" ordered Thornton. "The devil! Where would we get any oil?"

They heard a shout from the beach and turned to see Kelly racing across the sand with a fish in his hand. They watched him as he scrambled across a cluster of rocks and began to strike some unseen object with his club. At last he stood up and waved to them. Omnak had followed him, and Williams and Thornton were soon down to see what had happened. There, in the shoal pool, the sea lion was trying to force out from between two boulders.

"What have you?" shouted Thornton.

"Seal," replied Kelly.

Williams laughed.

"There's your answer," he said turning to his companion.

"Answer to what?" asked Thornton.

"Oil."

The two stood wondering for half a minute. Then Thornton slapped his thigh.

"By George, Williams," he cried, "we can do it!"

THAT evening, as the party was grouped about the fire eating fish and roast ducks, Williams told the others of Thornton's suggestion. Parker smiled cynically.

"Oh now really," he objected, "that's too much. Thornton, you're surely insane. Just because you manage to make a few crude metal tools you think you can do anything. Why there are plenty of well-equipped machine shops that couldn't make an engine. Be sensible. You'll waste months and then find your work and time thrown away. Perhaps you can build a boat. I know nothing of boat construction. But I know engines, and it can't be done."

"What part of it can't we do?" asked Thornton.

"Where would you get the proper metal for bearings, for instance?" asked Parker.

"We would get it," replied Thornton. "We'd use what we have."

"It would wear out in no time."

"Of course it would, but it would work while it lasted and it would last long enough."

Then began another series of questions similar to those that Williams had asked.

"How about valves?" demanded Parker at last. "You couldn't make them."

"Simplest thing in the world," replied Thornton. "We'd use spigots."

Parker sat back at it seemed useless.

"It would take you (Continued on page 120)

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Bare Hands

Continued from page 11

forever," he said finally. "Why on earth don't you go ahead with your boat and plan some less ridiculous method of propulsion? Oars, sails—anything but an engine. We can't afford to stay on this island while you try to build an engine."

The group burst into a loud laugh—the first they had indulged in since they had landed.

"There's no way to get away," said Williams, "except in our boat—unless somebody comes along and asks us to ride. If they come, we can go. If they don't, we had better be doing what we can for ourselves. An engine is the only thing. Maybe we can't build that—but we can try—and it's our only chance."

Parker sat glumly staring at the heavily charred fireplace.

"Well," he said at last, "it sounds silly to me, but go ahead and try if you think it's the only thing to do. Be as ridiculous as you want. But I want to get away from here. I certainly am sick of cedar bark and plain pain, rabbits and fish."

THEY started their work bravely enough, but after a week spent in making plans and sketches on the rocks and in the sand, in cutting trees and making wedges with which to split them, in talking over ideas and discussing mechanical difficulties, they were already finding that the task would be almost endless.

Williams decided on a thirty-foot boat, but before he could make anything more than the roughest kind of sketches he had to make himself a standard rule, and then had to search about for a rock large enough and sufficiently smooth to make possible a set of plans. In the meantime, Thornton and Kelly cut trees—thirty of them—and when Williams had finally made his plans and built a protecting thatch over them to keep the rain from washing them away, he lent a hand at splitting the logs.

Meanwhile Parker, aided by Oonuk, was very deliberately working on his fireplace. The task proved much more onerous than he had anticipated, and he rested as much as he worked. Still, he refused to give up, and slowly the fireplace was growing. Eventually, to the surprise of the others, it bade fair to become a good one. In its design, at any rate, Parker's theoretical knowledge had served him well.

THE two who stayed behind at the cave rarely went far from it. Oonuk still talked of devils and spirits, and had been quite long but reassured by the finding of Tugmak's dead body in the cave. The others had accepted the theory that the body had been dragged there by the other Aleut, Iguslik. But they had not found a single sign of human on the island, and save for the disappearance of several smoked eels that had been stored there, saw no other sign of the presence of any one else on the island, and soon noticed. Furthermore, Parker insisted that Oonuk himself had cooked the rabbits and that they had been eaten by the hungry group. Oonuk insisted that he knew better, but no one accepted his belief.

On the morning that Kuka Joe arrived, the three woodsmen were half a mile or so from their camp, at the top of the cliff and out of sight, engaged in splitting the trees that had been felled, and Parker was still busying himself on his fireplace. The poacher landed on the rocky point of Devil Island where it ran out to the north. He figured that if the yacht had gone aground, that long reeflike point was responsible. It was a desolate place, three miles north of where the party from the yacht was camped. Rocks lay stretched out into the sea, where the surf pounded madly upon them.

For half an hour Kuka Joe and his men rowed along the rocky shore in a small boat, and finally found a spot to land. Kuka Joe climbed to the top of a rock, from which he could survey almost the whole length of the reef. Not a sign of the yacht could he see. He wondered if, after all, the three Aleuts he had put on the yawl might not have been overpowered or bribed by the yachtsmen, and that even now, perhaps, the vessel lay in some safe harbor hundreds of miles away. He shook his head and started back to his boat. His men were holding it between two rocks in a tiny space hardly large enough to float it. He stepped in, and was about to take his place in the stern when he spied a bit of varnished wood floating in the water. He reached for it, and pulled it toward him. It was heavy, and he stepped back to the rock again to find out what it was. He pulled strenuously, and managed to get it up beside him. Across it in brass letters was the single word *Petrel*. It was the transom of the small boat from the yacht.

A LIGHT line, made fast to a metal ring bolted to the wood, trailed in the water. He pulled at it, and felt something heavy on its submerged end. He hauled it in, and felt back in astonishment when the ghastly face of Iguslik appeared at the surface of the water. The two men in the small boat grunted in alarm, and Kuka Joe let go the line and leaped back into the boat. What he had seen was obvious proof that the yacht had been wrecked on that treacherous reef. He never imagined that Iguslik, after endeavoring to get away with Tugmak, had rowed hopelessly for days, growing weaker every moment, only to be set back by the current and the wind, and finally exhausted in the storm. Tugmak, having been thrown into the sea, and having kept afloat for an hour or two, had been washed ashore three miles away, while Iguslik, who had made himself fast to the boat by means of the line, had been drowned at once and washed ashore on the rocks. There the pounding surf had splintered the boat to bits, leaving the unfortunate Aleut still tied to the varnished transom.

For a moment Kuka Joe congratulated himself safe in the belief that all on the yacht had been lost. But then it occurred to him that inasmuch as the yacht had not been wrecked at a place some of her passengers might readily enough have reached shore. It behooved him to investigate, although he did not particularly care for the task. He knew Devil Island, and knew its reputation. Do it was there, he was certain, but possibly he was not the only one he was after were there as well. He might have to take some present or other to appease the devils, and then, if he found the men he was looking for, he would take them away to that other island for which he was bound, where he had planned to put them when he first started out in company with the yawl.

CONSEQUENTLY, though he shivered at the thought of going ashore on the fourth island, he went back to his schooner and made ready. He ordered a few supplies put into the small boat, and sailing down along the island, he put off again toward the very beach on which the yacht's party had been washed up.

Noon was coming on, and Oonuk had just left the cave to take some food up the ravine to the woodsmen who were working on top of the cliff. Parker, alone near the cave, was getting more clay from the stream in order to plaster a few rough spots in his first bit of basket work. So vastly interested had the engineer become in his task that he paid no attention to Oonuk's departure, nor to anything else, until, glancing up from his work, he saw, to his amazement and delight, a two-masted schooner making her way slowly along the shoreline half a mile off the beach.

Instantly he dropped his work and ran to the water's edge, waving his arms frantically. It had happened! A ship was there, just as he had said it would be. (Continued on page 2)

Bare Hands

(Continued from page 120)

He cried out. He ran excitedly along the sand, waving his arms and shouting. He did not recognize Kuka Joe's schooner. It was merely a ship to him. His sole thought was to attract the attention of those on board to the fact that there was someone ashore who wished, above all other things, to be rescued. And apparently he succeeded, for he saw them lower the foresail, saw them glide in a little closer to the shore, and presently saw them come up into the wind and drop their anchor.

To his delight they put a small boat over the side. That certainly meant they were coming ashore. Parker hesitated a moment. Should he wait for them? Or should he hurry to where the others of the party were working on top of the cliff? He glanced at the small boat. Evidently there was some delay, for it lay bobbing beside the schooner, and as yet no one was in it. Perhaps he had better hurry to the others. He probably could get them down to the beach by the time the boat got ashore.

HE TURNED and ran at his best speed toward the ravine, up which led the path that he must take. He climbed over boulders and around rocks, panting and struggling, until he came upon Oumak, who was resting on a rock preparatory to returning to the cave.

"There's a ship, there!" panted Parker. "They have anchored just off the beach. Where are the others? We must get them. Come! Show me the way."

Oumak was far less excited over the coming of a ship than was Parker. He was comfortable on the island, despite his fear of devils. He was well fed and warm, and while he naturally wished to get back to his wife and numerous progeny, he was not wild over the prospect, and next year would be just as good as this. Bull, urged by Parker, led the engineer on up to the clump of trees where the other three were sleeping.

Once out of the ravine they could hear the sound of the axe, and Parker shouted:

"A ship! A ship! Hurry. She's sending a small boat ashore."

The others stopped their work and stood gaping.

"Hurry!" cried Parker. "I told you a ship would come!"

Convinced that Parker was telling the truth, they ran to the edge of the cliff, from which they could see out across the beach to where the schooner lay at anchor. Their hearts leaped with gladness as they watched the small boat coming ashore. Oumak was the first to speak.

"Kuka Joe, he come," grunted the Aleut.

Williams looked closely at the schooner.

"I thought it was too good to be true," he said.

"What do you mean!" demanded Parker.

"JUST what I said," replied Williams. "Ships just naturally aren't to be found in these waters from one year's end to the next, and to have one come along as soon was too good to be true. But of course, Kuka Joe naturally would come to see if we were alive or not. I'm glad we're up here. He'd get us sure if we were at the cave."

"Better get back out of sight," suggested Thornton. "There's no use giving him a clear view of us. We may be able to keep out of his way. Look. He's got his gun."

They saw the small boat approach the beach, where the surf was light, and saw the poacher standing in the bow with a rifle across his arm.

Parker looked at the others in disgust.

"Do you mean that you aren't going down and make him take us off?" he demanded.

"Make him take us off?" Thornton echoed. "Make him? Why, for the love of Pete! Do you think we could

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Bare Hands

Continued from page 121

make that scoundrel take us away from here and set us down safely where we would be safe?"

"Certainly we can," shouted Parker. "You have the imagination of a child. Do you suppose he means to harm us? Can't you see he has come here because he is afraid something has happened to us?"

The others looked at him in surprise.

"Do you trust that bird?" asked Williams.

"Certainly I trust him," replied Parker. "We can make it worth his while to take us to some means from which we can get back to Seattle, and I'm going to do it. You may act the fool if you wish, but I won't. I am going to talk to Kuska Joe."

"BUT, Parker," argued Thornton, "your life won't be safe for a moment once you are in his hands. Can't you—"

"I do not listen," interrupted Parker. "If you want to go with me, very well. If not, stay here. I don't care. I'm going to have a talk with him. I know I can convince him that he should take us off."

He turned about and trudged off, expecting Chunak, at least, to follow him. But Chunak did not, and Parker turned about after he had gone a dozen feet.

"Aren't you going, Chunak?" he asked.

Chunak shook his head.

"You are a pack of fools," growled Parker.

"Perhaps," replied Thornton. "But we'll stay here. I advise you not to go, but if you must, then say as little as you can of what we are doing. Be careful not to tell him that we are building a boat. We hope you get away all right. But watch your step. I'm afraid you're getting in trouble."

"Tommyrot," snorted Parker. "Well, I'm going. When I've made arrangements you can come if you wish. If you insist on being rebellious, you may stay until I can get in touch with the Coast Guard. It takes a situation of this kind, I suppose, to show men up, and certainly you all have been shown up."

He turned and walked angrily away again, disappearing among the trees that clustered about the head of the ravine.

"He'll get caught sure," muttered Kelly. "Or shot. He's crazy."

THEY all crept back to the edge of the cliff and peered in at keeping themselves hidden as well as they could. Below they saw Kuska Joe emerging from their cave. Luckily, they thought, they had all their tools with them, and so far, at least, he seemed not to have seen the blast furnace. Even if he should see it, he would not be likely to know what it was. They saw him look about and lift his gun, and then knew that Parker was approaching him. They held their breath, fearing he would fire, but he did not pull the trigger, and then Parker spoke to him. They were too far away to hear what passed between them, but they saw Kuska Joe wave to his two men who were waiting near the boat. The latter came running across the beach, and the watchers on the cliff gasped as they saw the two seize Parker by the arms and drag him roughly down to the boat, where they made him fast with a line. It was what they too feared.

Kuska Joe followed his prisoners, and they saw him lift a couple of packages from the small boat. Then he turned about and started back toward the ravine with his gun still under his arm and with the two packages in one hand.

"Do you suppose he's after us?" asked Williams.

Thornton peered over the cliff again, and observed that Parker was being guarded by one of the men from the boat, while the other, armed with a rifle, was following twenty yards or so behind Kuska Joe.

I wouldn't be (continued on page 127)

Bare Hands

(Continued from page 122)

surprised," nodded Thornton. "But he's got to come up the ravine if he wants us. Why can't we get over there and drop some stones down if he tries it? That might keep him back."

They looked once more over the edge of the cliff, and seeing that Kiska Joe and his follower were making directly for the ravine, they hurried to its edge, and loosened several boulders with which to drive the two newcomers back.

They could not see very far down the narrow canon, and they waited impatiently. They heard Kiska Joe's voice as he called something over his shoulder to the man who followed him, and then, between two huge boulders, they saw the poacher as he warily made his way up the gorge. His gun was ready, and his eyes were glancing in every direction. They poised their stones and kept themselves hidden, waiting the opportunity to sweep him back with the boulders they were ready to roll down. Again they heard him speak to his follower, and then they saw him appear below them. Another twenty feet up the ravine, and he would be below the stone that Kelly had poised.

They waited with rapidly beating hearts. No other weapons than the stones they had were theirs to use, and Kiska Joe had a repeating rifle in his hands. Still, they felt confident. On came the half-breed, advancing slowly and peering carefully all about. Kelly watched until he saw the fellow directly below him. Then he heaved his boulder over the edge.

Bare hands are pitted against modern rifle bullets in this desperate battle on the cliff. Can the deluge of stones halt the murderous advance of Kiska Joe? Can the castaways possibly escape? The greatest thrills of all await you in next month's installment.

Fire Shy

(Continued from page 17)

was worked up to the explosive point. He had taken the opportunity to make the remark while he and Pat were inspecting the cinder pit, Chuck being left to stand guard over the water valve lever on the charging floor. "If Lucy knew all about it——"

"Why don't he tell 'em himself?" said Pat without umbrage. "He's got a tongue in his head. No, jest you let him handle it his own way. As long as he does his work——"

"Work? He does his an' mine too," said Jerry. "He's saved me from pullin' a couple o' boners already. Knows steel twice as good as I do. Pod knows it—an' you know it."

"S'pose I give him your job, then," suggested Pat with that microscope look in his eye.

"Sure," said Jerry. "Ain't he first helper right this minute?" The fact that he hesitated the fraction of a second before making such a statement was not to his discredit at all; Pat's hand dropped on his shoulder to prove it.

"Maybe ya'll both be first helpers—some day," he said as he climbed out of the pit. "How's the heat comin'?"

"Fine. Chuck'll bring it down right if I can't," Jerry bragged as they parted.

WHICH was exactly what Pat hoped he would say, for he had arranged a double test; one for Jerry and one for Chuck. Pod's reports had prompted it.

"Chuck's as good as any man on the floor," Pod had said. "An' it suits me fine, 'cause I can be a melter again without worryin' about first helpin'. I got enough to do without workin' a furnace"

(Continued on page 124)

Fire Shy

(Continued from page ...)

"All right, we'll give 'em a try-out," said Pat. "They need an extra hand to keep 'em busy, an' we might get two first helpers out of it."

Then and there they had established a special heat of high carbon steel for Number Five furnace. Ninety carbon. "An" we want to catch the carbon on the way down. Pat had said to Jerry in the conference at Number Five's loading place. "Think ya can do it?"

"Sure, we can."

"All right, shoot."

A delicate job, catching the carbon on the way down. It is easy enough to work a heat without watching the carbon and to recarburize in the ladle, but to make carbon and all the other elements reach the right proportions at the moment the tapping temperature is right is a test for any man. If ever a heat was nursed, that one was. Jerry fussed over it like an expensive French chef over a salad. His calculations were checked and rechecked; the ore boil and the lime boil scrutinized with an eagle eye. And Chuck was there to confirm every conclusion on alertness in this event that was a joy to behold. If Jerry ever uncovers but he make a mistake, and actually make one, Chuck managed to correct him without being obtrusive, thereby winning Jerry's undying admiration.

LIKE that time when they took a carbon test just after the lime boil. In pursuit of his duties as second helper, Chuck plunged the test spoon into the lake of steel, pulled out a sample free from the slag that starred restlessly on its surface, and poured it into a mold. Even a little thing like that was marked by a professional air, as though he had never done anything else. Nor did he ever show the slightest curiosity of the fire inside. As long as it was where it should be he ignored it; that was the funny part of it. He cooled the sample, cracked it and handed it to Jerry.

I make it a hundred an' twenty carbon," was Jerry's conclusion. "Better ore it down some."

"Hundred an' ten did you say?" from Chuck. "Yes, might be a good idea to charge a little ore."

Jerry threw him a look that he should have had to remember in a lonesome moment, but he missed it. "Well, we'll hold off a while an' take another test," he said as though it were his decision.

Small wonder that Jerry had insisted that Chuck was actually first helping. Even now, as Pat hustled away across the floor and Jerry climbed the stairs to the charging floor, Chuck was doing the first helper's job. He was changing the drafts and watching the temperature of heat as a doctor watches a patient's pulse.

THAT was something Jerry could not do yet. To take a test spoon of metal, pour it out on the floor of cold steel plates in a certain slow fashion and tell from the way the metal froze exactly what the temperature of the bath was—that was the result of years of practice. Before Chuck had arrived, it had been necessary for Pat to do it, now—a cinch. So much of one that Pat had arranged for Pat to be called away suddenly, leaving the entire responsibility for the heat to Jerry and Chuck. An item of news that Chuck handed to Jerry when he had climbed to the charging floor.

"Pat just sent word he's been called away. Wants you to tap without waitin' for him."

Jerry was shrewd. He laughed. "Yeah, Pat's been leavin' us alone a lot lately. Knows he don't have to stick around when you're here. An' Pat just told me we might both be first helpers soon."

"Did he?" A jubilant light in Chuck's eyes—then a cloud. "Aw, what'll that get me?" he added, looking down.

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Fire Shy

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the floor. Jerry was almost discouraged, but he did not show it. "Well, let's smack this heat on the nose," he said with enthusiasm. "Pat knows what he's doin'."

From then on the two forgot everything but the necessity of keeping up their record of good heats. Things began to happen fast. The changing of drafts alternated with carbon and temperature tests; a quick dash around the furnace to be sure that the ladle was spotted in the pit below the tap hole, then more checks. Change the drafts oftener to bring the temperature up, but not too high, or the heat will be "burnt," and don't hold it too long, or the carbon drops too low.

IT WAS a wonder that the charging machine did not run them down. It lumbered by and they did not know it. Somehow they reacted to the rumbling vibration of its approach or the indifferent clank of its warning gong and got themselves out of the way without conscious effort. When a link of hot metal floated by overhead it, too, was unnoticed. The crane that bridged the floor had a much louder gong; the huge brick-lined kettle with its fifty tons of liquid fire was as big as a locomotive boiler, but they neither heard nor saw it.

At last "All set" from Chuck, and "Shoot" from Jerry.

Jerry picked up one of the long steel rabbling bars that lay piled just beyond the outer rail of the charging machine track and prepared to thrust it into the furnace through the center door. It was long enough to reach across the bottom to the tap hole—nearly thirty feet—and an inch and a half round, so it was heavy. Especially when it had to be lifted from one end. He strained backward, hoisted the point and walked toward the open door. Chuck had another job to do, as could not help him. He had to take a quarter turn to get around the furnace and open the tap hole from the outside when Jerry shouted the word. But before either of them took another step there was a shout from elsewhere. Not the kind of a signal that is generally heard on the charging floor but a sharp, high note of warning and terror—and it rang out the last almost in a scream.

"Look OUT!"

Chuck, headed toward the andiron beside the furnace, already faced in the direction from which the warning came and saw what happened—saw as the cry chilled every man who heard it. Jerry included. For he stopped in his tracks and jerked his head around. The great ladle of hot metal had been hauled before Number Three furnace, where Benny had set a trough in place ready to lead its fifty tons of liquid fire in through the center door of his furnace. Through lugs the ends that held it like the handle of a bucket, even the cable that sagged above it, were brilliantly spotlighted in the blast of light from that open door. The ladle had been lowered preparatory to tipping it and pouring the hot metal down the trough when something happened to the drum on which the cable was wound, and the steel rope paid out with a run. The ladle had only a few feet to drop, yet the impact of its enormous weight shook the elevated charging floor from end to end. The vibration and the cry—"Look OUT!"—swept down the floor simultaneously. At the same moment the two men, Benny and his helper, who stood near by, burst away from the spot like projectiles driven by the gunpowder of fear. Then followed an age-long moment of frozen inaction.

THE ladle had dropped on the top of a sprawling pile of dolomite that had recently been spilled on the floor between the charging machine tracks. The metal inside it was absorbing almost from the force of the fall, splashing over the rim a little and striking the floor in a shower of

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sparks. The ladle itself was teetering unsteadily on its slightly rounded bottom like a bucket with a dented bottom that sways when the water inside it is disturbed. If it tipped over—the slosh of molten steel along the littered floor would be like the flood of scrub-water from an overturned pail, scrub-water with a temperature of three thousand degrees, a slosh that would consume even the steel floor across which it would flood. If a mere man should be in its way

Chuck was the first one to break the years-long tension. He turned, took the few steps necessary to bring him to Jerry, and snatched from his hands the rabbling bar that was still half poised in the pit. His face was a sight. White, with pain in his eyes and a sweat on his brow. He was biting his lower lip. Then he faced forward that swaying ladle that tilted a little more in their direction with each returning wave of the metal it contained, and started toward it, bar in hand. Walking! Great long strides that were made with an effort like that of a man walking through water. He leaned forward like a fighter. He was fighting that craven that had showed in his eyes. Jerry woke up.

"Chuck! Come back!"

IT WAS heard, that was certain, for Chuck's head twisted slowly back and forth in negation. But those long strides continued. It was insanity. Utter folly to walk into that certain death. And—

"It's Jerry's job, let it go!" screamed Jerry.

Chuck strode on. Jerry saw the two chords at the back of his neck working alternately with each long step he took. The skin that tightened over them was white as death.

"Chuck! For God's sake!" Yap it.

Another slow shake of the head. Chuck was almost beneath the ladle that tipped a little more and slopped a little more. The rabbling bar was reversing itself in his hands, the tapped handle pointing toward it instead of the point. He looked like a pygmy with a toothpick against the towering steel-cased ladle of death, every rivet in the massive loops that bound it photographically distinct in the incandescence from the furnace.

Then Jerry gave over shouting and got into action. He followed Chuck. Not at a walk, but running, though his feet seemed to be moving with half the speed of Chuck's. Whatever Chuck had in mind to do, he should not face death alone. Before he could get to the spot Chuck was at work beneath the teetering destruction. He set the handle of his bar firmly beneath the steel band that bound the top of the ladle. A wave of steel slopped over as he did it. Some of it dripped down the bar on to his hands, but he was indifferent to it. He waited for the retreat of the wave of metal up there to tilt the ladle the other way. The point of his rabbling bar resting on the floor beside him. He was looking up, directly into the dripping of slag from its rim, into the rose-colored glow that marked the girders of the useless crane above. He was turning his back upon it, getting a grip on the inclined bar, preparing to heave on it with the backward tip of the ladle. It moved slowly. He staggered back with it, the point of his bar scraping along the floor until he had it braced against the inner rail of the charging machine track.

NOR did he release his grip even then and flee to a safe place of observation. He stayed there, his back rounded, great veins on his forehead, and braced himself for the return tilt of the ladle, to secure the point against possible slippage when the ponderous load was again applied to it. His back to the threat! Back it came slowly. A hissing slosh of metal over the brim, struck the floor behind him and showered

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Fire Shy

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sparks. The enormous load bore down on the resistance to its movement, the bar began to bend. Chuck, his arched back straining, paid no heed to the trickle of steel that slid down over his hands, he clung to the heavy bar that looked like a toothpick now—and waited. Its point did not slip, nor did it collapse; it took the strain like a spring and straightened again.

By this time Jerry had arrived. It had been necessary for him to dash to the outer side of the floor to a pile of bars, and with some superhuman strength imparted to him at the moment he was dragging three of them. During the next interval of swaying set up by that wave up there, the two men had set up the three additional braces and the danger was past. Between the cessation of Jerry's plea and the setting up of the bars there had been no sound save the thudding of Jerry's feet on the floor and the hissing splash of metal; now there was a bedlam. Shouts, cursings, the clatter of more bars being dragged up by men who set them in position, told the ladle was stationary, braced by a hedge of bars that slanted up around it.

PAT arrived, his face red from a long run. He had had to travel the width of the building and almost half its length, but his voice bellowed orders. The crippled crane was unhooked and rolled away, another one came up and took its place. The ladle was raised and promptly emptied into the waiting trough, the furnace door was closed. After that it was time to hear the story, and a babble of voices gave him the details. "Where's Chuck?"

He was sitting on Bony's bench, his hands a mess of charred flesh—hanging between his knees. Bony sat on one side of him babbling apologies and begging for a chance to show his gratitude, Jerry sat on the other, an arm about his shoulders, a hand using gauze from a first aid kit.

"Get the doctor!" bawled Pat at the crowd that was gathering.

"He's comin'," said Jerry impatiently. "Chuck's passed out."

With the gauze he gently wiped a dark trickle from Chuck's sagging chin. He had bitten completely through his lower lip.

"Did that whippin' it," whispered Jerry. "He was fightin' it every step."

"I knew he had the guts." Pat's big fingers gently raised the lower lip from the teeth that pierced it.

The doctor came, applied a swath of bandages to the seared hands, began to work on the legs, when Chuck's eyes opened slowly.

"Good job, lad." It was Pat's big voice, teasing. "An' a first helper's job when ya get headed up."

Chuck tried to make his thanks but found it difficult because of the doctor. His eyes spoke, however, then he turned them to his friend. Jerry, for some reason, could not speak. He only nodded his head with great vigor and beat a tattoo of congratulation upon Chuck's shoulder. Until a troubled look appeared in Chuck's eyes.

"Heat," he managed to say. "Lost!"

Pat's voice drowned out any other answer. "Heat lost? What of it?" he bellowed joyfully. "Ain't we got a he-man to make us another?"

Then, as the doctor and Jerry assisted Chuck toward the waiting ambulance, the great voice triumphantly took up its regular duties.

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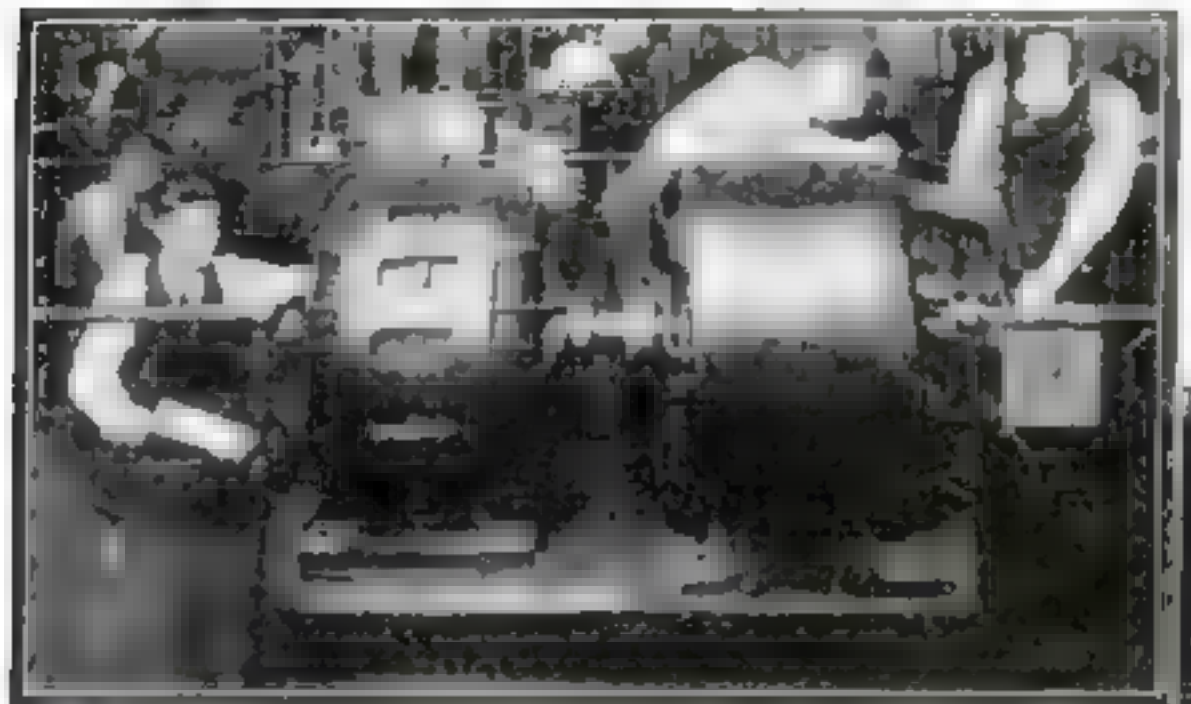

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The Most Spectacular Sport in the World

(Continued from page 12)

dangled before their eyes reaches amazing proportions.

Eddie Rickenbacker retired from automobile racing to take up an even more hazardous occupation—flying for his country in time of war. Richenbacker became the American ace of aces, with twenty-six enemy planes to his credit, and is still hale and hearty.

Ralph Mulford, once a great driver, and Louis Chevrolet, eldest of three great brothers who won fame on the track, are now automotive engineers. From their efforts, and from the work of men like them, the automobile world may expect such refinements as supercharging and an infinitely variable gear.

SOME of the veterans have been so successful that they are still at it. Earl Cooper, whose name first reached racing prominence as a member of the famous 1913 Stutz team, is still an active competitor and, to the utter amazement of followers of that strenuous sport, is getting better with his increasing years than he was in his youth. Ira Vail, a famous oldtimer, is said at the present time to be considered the dirt track champion of the East. Louis Disbrow, whose racing career has been a long and meritorious one, still drives on dirt tracks.

De Palma, hero of many a racing event and one of the most colorful figures of the track, has combined experimental engineering with his racing. He has devoted the past few years toward the development of a new fuel-saving car. In addition he still drives in races, though he has cut himself down to about ten events a year.

De Palma has always been an unquenchable enthusiast.

"The fun is about all there is to the racing game," he used to say, in the days when a driver risked his neck every time he took a steering wheel in his hands. "For the risk he takes, the race driver gets less money than any other professional sportsman. It is the fascination of the game that holds me to the track."

Lately his viewpoint has altered somewhat.

"TODAY it is the cash that the young man who enters the racing field is in search of, though it is only natural that he should wish to share in the glory of victory.

"Races such as the 500-mile contest at the Indianapolis Motor Speedway result in bringing more recruits into the racing game than any other event that I know of. Sometimes for a year or more months in advance of this classic I am besieged with inquiries from ambitious youths in all sections of the country asking for instructions as to how to become successful racing drivers. It is the $61,000 in prize money offered at Indianapolis that has this effect on the many young racing drivers."

De Palma has long been considered one of racing's hard luck drivers. True, he has won many honors and even finished first once in the Indianapolis classic, still, he has never been particularly blessed with good fortune. (Continued on page 136)

The Most Spectacular Sport

(Continued from page 135)

Once at Indianapolis, when he was leading, De Palma's car caught fire. With courage born of desperation he drove his flaming car to the pits, threw dirt on it, quenched the flames and started out again; but again fire shot out from under him, and this time he had to jump to save his life. That other occasion, when he pushed his car with his hands over the line, he was disqualified on the ground that his car hadn't traveled the entire distance of the race under its own power.

In a sensational Grand Prix race at Wauwatosa, Wis., won by Caleb Bragg, a courageous amateur, a millionaire who has now turned to speed-boating, De Palma's big Mercedes was overturned and he was badly hurt. On the last leg of that race, as De Palma attempted to pass Bragg, his car swerved and brushed up against Bragg's. The speedy amateur was not injured in the slightest, but De Palma's car was thrown off the track and crashed.

DE PALMA had a hunch not to enter that race. Just a few days before the event, David Bruce-Brown, his close friend, was killed while on a practice spin. De Palma was deeply affected, but finally consented to race. His own car was overturned almost at the exact spot where Bruce-Brown had met his death.

Bragg remembers the collision with De Palma.

"I was hit by a car going 105 miles an hour and lived to tell the tale—and won the race," he will tell you. "I was leading by two minutes, with only about a mile more to go. I was taking no chances now and slowed down to about seventy miles an hour to lessen the chances of a blow-out. De Palma, who had won the Vanderbilt Cup race just three days before, was behind me and making a desperate effort to catch up.

"We came to a very narrow section of the road. I had a clear road ahead. Suddenly, before I reached it, there was a terrific crash against the rear of my car. De Palma, going at a breakneck clip, had tried to pass me on the narrow crown of the road, but, veteran though he was, he swerved and hit me full from behind.

MY OWN car, wonderful to tell, was shot straight ahead at the increased speed, just as a billiard ball is forced ahead when another comes straight at it and hits it squarely on the cheek.

"I glanced behind in time to see De Palma's car rolling over and over into the ditch. It made mine an agonizing victory. I was mighty glad to learn that he would get well, which he did after weeks in a hospital."

That old rival of De Palma's, Barney Oldfield, retired happily from the racing game. When he decided to call racing off the first thing he did was junk the famous old Christie car that served him many years as a war horse. This car was looked upon as a freak, wicked and headstrong and treacherous, with a front-wheel drive and no differential, without a clutch or a crank. Yet it took to the bone yard many records up to distances of two miles.

Oldfield used to tell of a famous road race as his toughest experience. It was a race from Los Angeles to Phoenix, 673 miles, which Oldfield won in the time of 22 hours, 59 minutes and 35 seconds. Listen to him:

"Speedway races and contests on regular courses picked for their safety—easy! They're nothing to what we got in that Los Angeles to Phoenix race, 'cross country. It was my first big road race and I won it, but it had me worn to a frazzle before I finished.

"THREADING over steep, narrow mountain trails, covered with sharp flint boulders; along canyons and precipices; through deserts and quicksand washes; blinding, powdery alkali dust—all these I encountered. We had torrents of rain and we forded deep swollen streams, we took bumps that strained us and our engines to the breaking point, we tackled road that racked the cars almost to pieces, we negotiated prairie grass that slipped every time we put on speed and cactus that cut the tires to pieces.

"But my Stutz romped in first. There were twenty starters and only eleven were able to finish, hours apart. It was my toughest race."

As the new racing season opens, revel in the glorious memories of the past, if you like, but keep one eye open and one ear cocked for Harry Hartz, the present champion. This young man has something of the heroic about him, something reminiscent of the days when racing cars bore picturesque names and not merely the prosaic numbers to which they are restricted today. Hartz, somehow, brings back to memory such magnetic speed demons as the Blitzen Benz, the Bullets of various sorts, and the spectacular Lampo or "Ray of Light," that the Italian, Lancia, had painted the color of the rising sun.

In 1926, Hartz won the annual championship awarded by the Contest Board of the American Automobile Association after a close struggle with Peter de Paolo, 1925 champion and nephew of De Palma.

HARTZ won his championship after a thrilling campaign in which he broke record after record. He set a world's record for racing cars with small bore engines (smaller than Ford engines) at Salem, N. H., by going 200 miles at an average speed of 128 miles an hour. He set a new mark for fifty miles at Culver City by reaching a clip of 135.2 miles an hour. He hung up a new record for 300 miles at the opening of the Atlantic City Motor Speedway by going 300 miles at an average speed of 134.1 miles an hour.

Watch Hartz and watch his young rivals, De Paolo and Bennett Hill and Frank Lockhart and Earl Devore. Racing in wild automobiles may be a study for veterans, but it's a sport for youth!"

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Glenn Curtiss

(Continued from page 86)

all contributed by Mrs. Alexander Graham Bell, had been spent in the A. E. A.'s experimental work, with tremendous results.

Dr. Bell invited Glenn Curtiss to join him in the development of the tetrahedral kite but the man from Hammondsport had already decided to go ahead with airplane development along his own ideas.

The first international aviation meet was scheduled for August 22nd to 29th at Rheims, France. There were prizes of many kinds, for every imaginable flying event, with the Gordon Bennett prize of $5,000 and a cup for the winner of the principal race. The Aero Club of America had nominated Glenn Curtiss as the American entrant. Before he went to New York to fly, he had his plans complete for the machine in which he hoped to beat the European contestants. Even while he was flying at Mineola that first time, his mechanics, back at Hammondsport, were at work behind locked doors on the fifty h. p., eight-cylinder engine on which he pinned his faith.

THERE had been a protest from the Wright brothers against the efforts of the A. E. A. to build flying machines, their patent, they claimed, covered every possible means of flight. Curtiss stoutly maintained that if they had thought of the aileron they would have included it in their patent. They replied that the aileron was part of the main supporting surface and so was included in their patent, which covered any warping or deforming of the planes themselves. Glenn Curtiss' answer to that was to design his plane for the Rheims event with the ailerons entirely detached from the main planes, set between the upper and lower wings, one on each side. And to this the Wrights rejoined by obtaining an injunction, restraining the A. E. A. and Curtiss personally from manufacturing or selling planes without first paying the Wrights for a license. The injunction was served just as Curtiss was finishing his preparations for his European trip.

It was day and night work, between the Mineola event and the date of the Rheims meet, to get his engine and plane in shape. There was time only for a quick test of the engine on the block before catching the steamer at New York. All the way over the question never left Curtiss' mind: "Can I win?"

THE French had been developing the monoplane. There had been some wonderful flights made over there. Sixty miles an hour, according to the newspaper dispatches. Blériot had a monoplane of his own design. Hubert Latham was flying an Antoinette. Could a biplane of any power beat a monoplane? Nobody knew, but Glenn Curtiss knew from his own experience that newspaper reports of air speed were usually exaggerated.

Plane and motor had to be taken to Rheims from the ship as personal baggage, the time

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Glenn Curtiss

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was so short. The Yankee airman arrived to find everybody predicting that Bleriot would win.

"My own personal hopes lay in my motor" he told me. "I believed that I had the most power that had ever been put into an airplane, more than enough to counteract the supposedly greater natural speed of the monoplane. But on arriving at Rheims I found that Bleriot, having learned in some way that I was bringing an eight-cylinder engine, had himself installed an eight, of eighty horsepower, in one of his light monoplanes. I never found out how the news of my motor leaked out, but it was clear that it had leaked. I felt then that my chances were very slim indeed. I had just one plane and one motor. If I smashed either, America's chances were gone. The Frenchmen had reserve equipment and, incidentally smashed many of their machines. Once, while flying, I counted twelve wrecked or disabled machines on the ground."

And all the planes ever built in America up to then did not total a dozen!

A HARD situation for a patriotic flying man. Hard to resist the importunities of American visitors urging him to contest for the rich prizes which the Frenchmen were capturing daily. Hard to stand their jeers when he steadfastly refused to risk his and his country's chance at the main event merely to "show off." Doubly hard for one born with a craving for speed, accustomed to entering and winning every kind of race.

Pat nuce and self-control won. He had mapped out a course of action and he stuck to it. He would not enter any of the duration events, none of the speed contests except those under twenty kilometers, the Gordon Bennett distance. And when the meet was over, after ten official flights and many more test flights, Glenn Curtiss was the only plane which had landed safely at the hangar after every flight!

THE French understood his stand no better than did the American visitors. The rangy young man who looked so much like the cartoons of "Uncle Sam" captured the Gallic imagination. The resemblance was heightened by the goatee young Curtiss was wearing, to protect a scar on his chin, a memento he still carries of a smash at Baddeck when his windshield ran into a boathouse. "Tod" Shriver, alias "Slim," the mechanic Curtiss had brought from Hammondsport, also appealed to the French crowd. "Picturesque," the Paris journalists dubbed him, because he worked in his short sleeves! French *mécaniciens* all wore smocks. "We must be the most picturesque nation on earth," said "Slim" dryly. He was later to take the first plane to Japan, to fly in 1911 at Tokio before a crowd estimated at 700,000 persons, a crowd so great that six months later, after Shriver had crashed to his death in Porto Rico, the assemblage from all over Japan had not dispersed! (Continued on page 140)

Glenn Curtiss

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The French contestants were kind to the unassertive, self-contained American flyer who did not brag, did not take unnecessary chances. His laminated wood propellers were a curiosity to them, they had only solid wood or metal ones. Chauviere, who built Blériot's monoplane made a propeller and gave it to Curtiss despite the fact that a better propeller would lessen French chances for the Gordon Bennett cup. But when it came to the race, Glenn Curtiss chose one of his own. It was an all-American machine which flew over the Plain of Bethany that day.

Tryouts, carefully timed, early demonstrated that the great event lay between Curtiss and Blériot. With motor throttled down, the Yankee covered the course one day a few seconds faster than the best the Frenchman had shown in the earlier events. Heartened, he waited for the morning of the 29th.

BLERIOT, Lefebvre and Latham were to fly for France; Cockburn for England. Blériot, already famous for his cross-channel flight, was the favorite. During the Rheims week he had picked up prize after prize, for speed, for distance. Each contestant was permitted to select an hour for his trial flight before the official start. Curtiss chose ten o'clock. Throttled down throughout the first lap, his plane pitching with distressing violence in the heat waves rising from the Bethany Plain, he made the two circuits in seven minutes, fifty-five seconds, a new record for the course. Now was the time to start after that Gordon Bennett prize, now, with everything running perfectly. He refilled the tank, notified the judges and was off.

"I climbed as high as I thought I might without protest before crossing the starting line," Glenn Curtiss told me. "I got up probably five hundred feet. I thought the gradual descent would help my speed, and it did.

Strategy learned in those earlier bicycle-racing and motorcycle-racing days.

THE sun is hot, the air rough. Throttle wide open, he cuts the corners as closely as he dares, banks high on the turns and flies as no man ever flew before. Once around the course—ten kilometers; around again, twenty. He lands beyond the tribune and the official time goes up.

Fifteen minutes and fifty seconds; an average of forty-six and one half miles an hour; a world's record! Speed king of the air for the moment, as he is already speed king of the land.

Immense enthusiasm among the American spectators. The venerable Andrew D. White waves his hat frantically. Mrs. Theodore Roosevelt and her daughter Ethel applaud vigorously. Archie and Quentin Roosevelt cheer with boyish enthusiasm. Many think the race won, but they are crowing before they are out of the woods. Curtiss has set a mark for the others to shoot at, and some one is bound to beat it if the speed is in his plane.

"I felt like a prisoner awaiting the jury's verdict," he told me. "I had great respect for Blériot's ability. Latham and his Antoinette might do better than they had shown."

Cockburn, the Englishman, starts. He makes a forced landing in a haystack, gets into the air again and finishes the course in more than twenty minutes—out of it. Latham starts in the afternoon. He finishes five minutes behind Curtiss' score. None of the others does better than thirty-five miles an hour. At last it is Blériot's turn.

ALL day he has been tinkering with his monoplane, testing different propellers, making changes. Late in the afternoon he rolls it out, his Number 22, with its eight-cylinder, water-cooled engine, four-bladed, geared-down propeller. The burst of speed with which he starts looks to Glenn Curtiss as if it were twice as fast as his own. Cortlandt Field Bishop and his brother, David Wolfe Bishop, pick Curtiss up in their car and drive to the judge's stand.

The Frenchman's first lap is faster than the Yankee's. They resolve then and there to build another and faster plane and come after the prize next year. Blériot comes around again. It looks as if he were traveling a mile a minute. He lands. Cortlandt Bishop runs to the judge's stand. Curtiss in the car, wonders why the crowd is not cheering.

"You won!" cries Bishop. "You beat Blériot by six seconds!"

The Yankee airman's heart leaps as the Stars and Stripes run up to the flagpole's peak and every American's hat comes off. Now they are cheering. The French are silent, but the Americans make up in noise for the thinness of their ranks. They swarm around the new-crowned King of the Air, enthroned in the Bishop car. "Bully!" cries Quentin in true Roosevelt fashion. Archie wants to know all about the workings of the machine. Blériot, good sportsman, offers congratulations and promises to come to America in 1910 to bring the cup back.

It is a triumph for America and the biplane no less than for Glenn Curtiss.

OFFERS of engagements to fly in public poured in on Curtiss from Germany, from England, from Italy. Huge prizes were hung up. He accepted some of the challenges and won, for he had the fastest flying machine in the world. And then at Brescia, Italy, he set another world's record by taking up the first passenger ever carried in a 'plane—Gabriele D'Annunzio, world-famous man of letters.

The grand prize at Brescia safely pocketed, Glenn Curtiss hurried back to America, to keep his promise to fly at the Hudson-Fulton celebration and to find means with which to defend himself against the Wrights' charge of patent infringement.

A fourth fascinating installment of Mr. Stockbridge's remarkable series on the great American aviation pioneer will appear in the next issue.

Are You a Throttle Hopper?

(Continued from page 60)

snapped Stebbins. "May I ask how you dopes that out?"

"Sure," Gus replied. "You're what I call a throttle hopper, a driver who takes a lot of pleasure in stepping on it to see how fast the car will pick up, and then lets the pedal clear up when the car gets going too fast. Sort of a feast or famine business all the time. That kind of driving will knock the spots out of any car.

"Looks to me as though you've broken the propeller shaft," he went on, inspecting the car. "I twisted it right off. It's a shame, too, because when parts like that break it's sure proof that you've been treating the bus rough. You can be glad it wasn't the crankshaft of the motor or something else that would run to a lot of money."

"YOU ought to go easy on the throttle the way I do," Spuds chimed in. "There ain't no sense in socking the gas to it. Ease it on gentlelike and give the motor a chance to get the car going. Light footwork on the gas and brake pays big unless your aiming to make Gus, here, rich. Me, I handle a car like it was a lightweight in the ring with me, giving a sparring exhibition at one of them charity affairs."

"Hold on a minute," Gus interrupted. "It's a good thing for you that the drive shaft let go when it did. If it hadn't you'd probably have gone right off the road at the next curve. Just look at this!"

Stebbins and Spuds went around to the front where Gus was examining the steering gear.

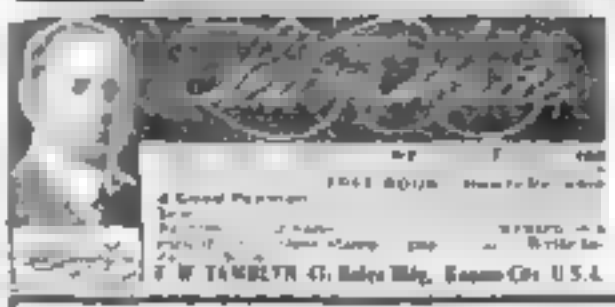
"One more yank on the steering wheel while the car was traveling fast would have snapped the ball right out of the socket in the drag link. Look—the cotter pin's out and the adjusting nut has worked loose. If that had happened, you'd have lost control of the car completely."

"I NOTICED that there seemed to be a lot of play in the steering wheel," said Stebbins. "I was going to speak to you about it the next time I stopped in here."

"It's lucky for you there is a next time," grunted Gus. "It's all right to take a chance and run a car with a tire that is near blowing out if you drive slow and there's a lot of other things that can break on a car without doing any more damage than to leave you stranded. But if anything goes wrong with the steering gear and you don't get all smashed up, you're luckier than most."

Gus was warming to his subject. "And the steering gear isn't the only part that suffers when you're a throttle hopper. The differential gears will show a lot of wear from using too much power while you're going around curves. The universal joints, I'll bet, are worn loose, and loose universal joints put just so much extra strain on the drive shaft.

Stebbins smiled sheepishly. "Maybe you're right," he admitted. "Hereafter I'm going to treat this car like a crate of eggs—unless somebody tries to pass me on a hill!"



If I Fall into the Sea—

Continued from page 21

can daily correct the errors of both by azimuths of the sun. In contrast, the plane cannot carry a gyro compass because of its weight, and a magnetic compass is always at the mercy of masses of metal surrounding it.

You can readily see how enormously vital small errors are to the trans-Atlantic pilot when his plane may have an extreme radius of only 4,000 miles, or just 600 miles to spare above the 3,600 he must cover to reach his destination. That figure of 4,000 miles is roughly the upper limit of endurance we have reached today, for the type of plane practicable for the New York-Paris effort.

THE eyes of designers are focused on a trans-Atlantic flight because it will throw light on many of their pressing problems. Long ocean flights, for example, are the only means of testing amphibian planes, planes that are safe over water as well as land. Since this is the most important passenger-carrying class of planes, it deserves the most attention. Landing gear for a seaplane and boating qualities for a land plane are wretchedly difficult impediments to combine in the same machine.

For a long time I have been studying structural materials. Only a few weeks ago a skilled metallurgist declared that his microscope tests showed defects in metal from the ill-fated *Shenandoah*. Captain Ramsey's tragic crash came from failure of his landing gear. Broken struts nearly cost Bennett and me our lives in Spitzbergen last May.

Nothing could better test the steel duralumin, insulation, wood, and other materials that go to make an airplane than the terrific strain of a nonstop flight across the Atlantic.

IN MY polar flight I used an air-cooled engine. Yet the Navy also is developing the water-cooled type. Already in the latter class are proved engines ranging from 200 to 800 horsepower. Air-cooled naval engines are standardized in three types: 200, 400 and 800 horsepower. The durability of both types has increased considerably in the past year, and many are now running well over 500 hours without major overhaul. Review of this phase of the whole situation leaves me still inclined to favor the air-cooled engine for the flight over the Atlantic. My plane will be driven by three Wright motors of 220 horsepower each.

I don't want to be too speculative in my hopes for the future. But I suspect we are on the threshold of high speed air travel through the upper strata of the atmosphere. Macready's marvelous work at Dayton in temperatures around 30° below zero, at altitudes above 40,000 feet has shown we can ride safely that high. Push this ceiling up only a few thousand feet more and speeds up to 1,000 miles an hour will be possible. That means circling the globe in a day.

But the next move is an American-Europe air line. The man who makes the first New York-Paris hop will lay the cornerstone of this great structure.

Magic Fingers Win Fame

(Continued from page 51)

"Easy!" he explained as we stood in his little five by fifteen foot workshop over the garage at the Bok home. "Every artist who is traveling spends about sixty percent of his time on trains. His concerts last only about one hour and forty-five minutes. Practicing accounts for another hour. While I am on trains or waiting for trains, I have plenty of time to plan devices and make sketches. When my tour is over and I get to my home at Aiken, South Carolina, or here, or at my place in Switzerland, I go right to work experimenting. If, before starting on tour, I find some device under way and had come to an impasse, I find upon returning to the workshop that I have a new perspective.

"TAKE this, my latest invention," he continued, leading me to the keyboard of a piano which rested on his workbench. "Before leaving on my last tour I had reached a point on this device where it seemed I could go no further. But since coming back the difficulty has been cleared up entirely."

This latest brain-child of the great virtuoso-inventor is an apparatus to record automatically the pianistic touch on a paper roll such as is used on artistic player pianos. Technically speaking, it records the impart of the pianist's arms, wrists, hands or fingers on the keys of a piano, actuating a device which automatically will mark or perforate the music roll to correspond with the dynamic expression of the pianist's effort. The desired effort is to record exactly the shades of expression that differentiate the inspired playing of a master from the merely mechanical excellence of the average trained musician.

Hofmann inherited his penchant for invention. His father, a noted musician, was little interested in mechanics, but his grandfather, a surgeon, maintained a completely equipped workshop where he invented a number of instruments for use in surgical operations.

IT IS probable, however, that Hofmann never would have invented anything more than the folding skates and the piano pedal extension device had it not been for Alfred Joel, the lad he told his mother he was going to see the day he had the skates hidden under his coat.

"Joel was a mechanical and electrical genius," said Hofmann. "It was he who first interested me in making mechanical toys and installing electrical equipment in them. Incidentally Joel is today putting the spring on the Swiss market."

Watching Hofmann at work in his little shop over Edward Bok's garage, it occurred to me that I had never seen a man perform a task with greater pleasure. His strong, sensitive fingers moved lovingly over the delicate mechanism on which he worked. On his face was the look of an explorer entering unknown realms. It wasn't hard to believe that that same look was on his face that afternoon forty-two years ago when he ran joyously through the streets of Berlin to join the merry-makers on the Spree river.

Is Your Yard Yours?

(Continued from page 35)

ways as parts of their boundaries, and one of the four uses a mountain range.

Such natural markings, however, very often have led to difficulties. It was because of increasing controversies and confusion that the necessity arose for some accurately fixed starting point for all boundaries.

As knowledge of the earth and of its shape grew, limits in latitude were assigned to property. This was the case in many of the grants of land in the New World early in the seventeenth century. Most of these grants included all territory between certain latitudes, and from ocean to ocean. Longitudes were not used until about two hundred years later, and until about fifteen years ago, nearly every country maintained a separate zero longitude.

EVEN with latitude limits to work with, there was no end of trouble in fixing dividing lines during the early formation of the United States. As the various colonies and states and territories were formed, their boundaries became a continuous source of contention.

While latitude boundaries were accurately made in the eighteenth century (Mason and Dixon's Line, run in 1767, stood the test of a re-survey 140 years later), many which were marked later were carelessly run or were made with faulty instruments. Changes in the variation of the compass accounted for some errors, while many points were poorly marked.

It was to be expected that disputes would arise when the boundary of a state began at "a cedar stake" and extended "in a certain direction through the boundary house." The cedar stake could not last forever, and the house might burn down. If a waterway was used, the marker might be a rock in the middle of the stream and "two feet under the surface of the water."

There is hardly a state in the Union which has not had her boundaries shifted, or which has not acquired or lost land. When rivers changed their beds, the land thereby joined to another state was sometimes legally transferred to its neighbor, and sometimes not. Arkansas has a tract of five or more square miles now east of the Mississippi, and Tennessee twenty-five miles west of that river, due to cut-offs of two double bends. Rather inconvenient for the dwellers thereon, but they can see their state across the river, and if they want to go to the county seat, they can take a boat!

PARTS of states and territories have been juggled here and there by state commissions or by Congress to compensate for land taken away by surveyors or claimed by other states. Massachusetts, for example, has an area of about four square miles extending into Connecticut to offset an equivalent inroad.

Some boundaries have been designated as in the "center of the river." As a result, the courts have had to decide whether the center of the channel was meant. Some have been placed at the high water mark and some at the low water mark. Maryland's original charter for example, placing her boundary at the high water mark on the Virginia side of the Potomac, led to a dispute which eventually was settled when arbitrators gave Virginia to the low water mark under "squatters' rights," and Congress approved the award. When it came to the District of Columbia, however, the Supreme Court gave the District to the high water mark.

MODERN methods and modern instruments have done away with many excuses for inaccurate surveys. The location for the various starting points, or main triangulation points, for a survey are accurately fixed in the United States by referring back to the "zero mark" in Washington, with such modifications as geodesy requires. From these main points, and from intermediate points, your property is located.

The national "zero mark" is located on what is known as the Washington meridian. That is, the geographical north and south line running through the national capital. Its exact location is in the center of the clock house of the U. S. Naval Observatory. The Washington meridian was first specified in 1845, when Congress approved the admission of Iowa as a state, and was formally legalized in 1850. It was used exclusively until 1913, when the Prime Meridian of Greenwich was specified for official calculations. The boundaries of Oklahoma were, however, referred to the Greenwich Meridian in 1900, and both meridians were mentioned when New Mexico was admitted in 1912.

Since then, however, by usage and necessity, if not by law, the meridian of Washington has continued as the "zero mark" of the United States for all practical purposes.

OF ALL the states in the Union, Colorado and Wyoming, the only states bounded by four supposedly straight lines, have their entire boundaries defined by reference to zero marks. One other state, Utah, has six straight lines, and all the rest have some of the "fifty seven varieties."

But how are the points on the boundaries located?

A point can be absolutely established only by giving its exact latitude and longitude, much in the same way that we fix a point in a city by the intersection of two streets. Latitudes, the east-west lines, are fairly easily found by astronomy, even if they are based on that imaginary line, the equator. But longitudes, the north-south lines, which depend on the other imaginary line, a prime meridian, were more difficult to determine accurately until recent times. Even now running a straight line between two points in the same longitude, and a few degrees of latitude apart, is extremely difficult. It requires the most precise scientific calculations.

If the scientists (Continued on page 145

Is Your Yard Yours?

(Continued from page 144)

find, as they are now trying to ascertain, that the continents are shifting, then we may have more trouble.

Eclipses of Jupiter's moons, lunar culminations and lunar distances were used in early longitude determinations. Next chronometers were used. But not until the coming of the telegraph, with time signals sent from the Naval Observatory at Washington, were accurate determinations possible. And it was only when radio came that determinations of the highest accuracy could be made anywhere on earth within sound of the "Naval Observatory" time signals. It may be remarked in passing that Australia used our signals in the determination of some of her boundaries. In Canada one observation station has had to be shifted *on the map* about fifteen miles as a result of surveys using these "time signals."

TIME, as determined by the position of sun and stars, is the basis of all our geographical calculations. We know, for example, that when the sun is on the meridian (that is, on the line running due north and south) in any given locality, then it is noon in that locality. Also when it is noon in one locality, it may be an hour before noon in another, and an hour after noon in still another. Since the difference in the longitude of two places is proportional to the difference between their respective "times," all that is necessary to determine the longitude of any certain place is to find accurately the difference between its time and that of a meridian specified as a "zero mark," or standard reference. This is done now by observations of certain stars, because they give more accurate results than does the sun.

Since the Naval Observatory at Washington is the official source of "time" for the United States, and since it is accurately located with reference to the prime meridian at Greenwich (the "zero mark" for longitudes of the world), and since it sends out time signals twice daily by radio, the calculations of longitude now are comparatively simple. At any point to be located all the observer has to do is to "shoot a time star" with his transit, and then compare *his* "time" with the signals which are sent out by wireless from Washington.

THE possible error of each signal is measured at the Naval Observatory to the thousandth of a second. The time it takes the signal to go through the transmitting instruments, and the time it takes to travel through the air to the observer, are calculated. While .001 second of longitude equals about one foot in the latitude of Washington and New York, boundaries in those and other large cities are measured to the fraction of an inch from the primary marks.

So, on America's "zero mark" at the U. S. Naval Observatory, in Latitude 38° 55' 14.0" North, Longitude 5 hrs. 8 min. 1.78 sec. West, and 280.89 feet above the sea level, does the location of your property depend. This holds true wherever your lot may be.

Here Are Correct Answers to Questions on Page 55

1. Until recent years this curious vegetable was a rarity in America. The fact that it is now so much consumed is due to the development of a great artichoke industry near Half Moon Bay, California. [illegible] is very foggy, and fog is good for artichokes.

2. Kansas. North Dakota is second.

3. The northern lights frequently are visible as far south as the northern border of the United States. They can be seen [illegible] farther north than this—in Labrador, Alaska, or northern Canada. In Europe and Asia the last positions for seeing the lights are farther north than in North America, probably because the lights tend to center around the Magnetic Pole rather than around the true North Pole.

4. These are believed to be relics found recently in an ancient lava flow near the City of Mexico, consisting of bones, pottery and other parts. Possibly 8,000 years old, they are certainly much older than the civilizations of the Aztecs or Mayas.

5. In making the voyage on which he discovered America, Columbus believed he was going to India. Accordingly, when he made his landfall on the Bahama Islands and encountered natives, he believed they were subjects of the emperor of India. It was many years after this, and Columbus was dead, before men were sure that the islands were really outposts of a new continent and not a part of the archipelago of Asia.

6. Most of the world's supply of emeralds comes from mines in Colombia, South America. The stones are very ancient, having been worked by the prehistoric inhabitants of the continent.

7. This is the famous Eisteddfod, held every year in Wales. To this festival, people come from all over Wales and the best singers are acclaimed as national heroes.

8. Far out in the Atlantic west of the Canary Islands, ships sometimes encounter sandstorms so thick that a layer of dust is deposited on the decks and seeps through closed portholes. Weather experts believe this dust comes from the Sahara Desert.

9. No. In the records of the ancient Babylonians, written long before the Bible, there is found an account of a great flood that destroyed most of the world. In many ways this account is like the Biblical account. Modern scholars incline to the opinion that both stories refer to some flood that occurred in the valley of Babylonia.

10. Cambodia is a part of Indo-China, south and east of Siam. The country is covered with jungle, but deep in the heart of this jungle venturesome travelers have discovered the ruins of vast stone palaces, now abandoned. The history of the ruins is entirely lost.

11. Any one who has read stories of the South Seas has heard of copra. It is the dried meat of the coconut.

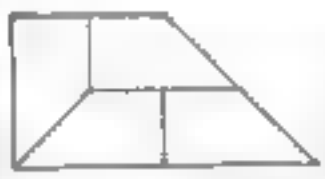
12. On South Sea islands there lives a variety of crab, the largest in the world. These crabs pick up coconuts and dig out the "eyes" of the nut. Through these holes they extract the meat. Sometimes they even lift the nuts and smash them on the ground to get at the edible meat inside.

Answers to the Sam Loyd Tests on Page 68

The Joker in the Scales

The method of ascertaining the true weight of an article weighed on an off-center scale is to take the square root of the product of the amounts registered on the two sides. In the sketch, these amounts were 8 and 6¼. The square root of their product, 7, is the true weight of the bottle. It is a simple problem in proportion. In the upper sketch the 8 oz. weight is to the bottle as the bottle is to the lower sketch is to the 6¼ oz. weight. If you figured this out in a dozen minutes, you earned a good rating.

Mental Scissors Cutting



Here is how the figure is divided. You should have reached this solution in a ten-minute mental jaunt.

Tricky Digits

The digits are grouped as follows:

7 9 — 8 3 — 5 6 4 = 8 4 7 — 8 6 3

The Nine-Celled Square

Here is how the four rows of similar length can be grouped to form the design. You earned a good rating if you solved this in fifteen minutes.

A Visual Promenade

Visit the cells in the following order: 1, 8, 9, 4, 11, 6, 7, 2, 9, 10, 5 and 12. Fifteen minutes to solve this is good time.

The Circulating Coin

The coin was one cent, which messenger 45 gave to 98 on account. 98 passed it on to messenger 74, leaving his debt balance 1 cent. 74 paid it to 45, which left his balance 1 cent. Then 45, having his cent back, again paid another third of his debt to 98, who immediately paid 74 in full. Then 74 squared his account with 45, and 45 cleaned up the situation by passing the coin to 98. Ten minutes to solve this earns a good rating.

Answers to the Mechanical Tests on Page 32

Block Test

The number of touching blocks in each case are as follows: A 3, B-6, C-6, D-7, E 5, F 4, G-3, H 4, I-6, K 5, L-5, M 3, N 4, O-3, P 4, Q-3, R 4, S-6, T 5, U 4, V 4, W-3, X-3, Y-4, Z-6, a 5, b-5, c-4, d-6.

Tangled Line Test

Reading from top to bottom in the right-hand columns, the correct numbers are:

Figure A—9, 4, 5, 1, 10, 8, 6 and 7, blank, 2, 3.

Figure B—5 and 7, 8, 10, 2, 4, 6, blank, 1, 3, 9.

Figure C—9, blank, 3 and 10, 8, 7, 1, 4, 5, 2, 6.

Figure D—Blank, 1, 3, 6, 5, 10, 8, 2 and 9, 4, 7.

Make More Money

Read the Money Making Opportunities on pages 129 to 151 of this issue.

Smoke Costs You $16 a Year

Continued from page 30

dwellers would, if placed in a row, extend for a distance of nine miles!

A striking demonstration of how the soot menace can be overcome by scientific methods was given not long ago in Salt Lake City. There, in an air-cleaning crusade directed by the Bureau of Mines, soot in the business sections was reduced ninety-five percent. Householders were shown how, by simple methods of selecting and burning bituminous coal, they might cut down the production of smoke enormously. Firemen in industrial plants and on railway locomotives were instructed in firing methods that not only cleared the air but saved huge fuel bills for their employers.

IN ADDITION an inspector was stationed at a vantage point on the twentieth floor of an office building. During the daytime he kept a lookout for smoke from chimneys, and immediately telephoned a warning to any factory which violated smoke regulations. At night, a searchlight was mounted on the building, and its beam focused on one section of the city after another!

As for reducing other forms of dangerous dust, some of our large cities now are directing attacks on street cleaning methods that raise dust instead of laying it on garbage and ash wagons that go about the streets unscreened, and on city dumps. Municipal incinerator plants are being widely adopted.

Efforts are even being made to prevent the beating of carpets and shaking of dust cloths in the open air. Citizens are being educated not to litter the streets with refuse and not to leave garbage exposed.

An interesting analysis made recently in New York City of air samples taken at various levels showed that dust particles are continually drifting downward from the higher levels toward the ground. In a cubic foot of New York air near the pavement, the investigators found about 200,000 dust particles, including thousands of germs. A single story higher the number of particles diminished by half.

SAMPLES of dust accumulated in public buildings revealed anywhere from 1,000,000 to 50,000,000 bacteria in every ounce. An ounce of dust from a Broadway theater yielded 7,092,000 bacteria; a Fifth Avenue church, 9,672,000; a new hotel 10,440,000; a larger office building, 25,160,000, and a subway station, 50,200,000!

Subway stations have presented an unusual problem; for there, it has been found, the atmosphere is heavily laden with fine particles of steel! This steel dust arises from the constant wearing away of steel car wheels, brake shoes and rails. Tons of it are breathed in annually.

An equally difficult problem is that of poisonous exhaust gases from automobiles. On the busiest thoroughfares carbon monoxide in the atmosphere sometimes becomes so dense as to cause fatigue and headache.

To aid in combating the problem of dust and soot, wonderfully delicate instruments have been developed by the U. S. Bureau of Mines, the U. S. Public Health Service, and the American Society of Heating and Ventilating Engineers. In some of them the dust-laden air is hurled at high velocity against a wetted glass surface to which the dust adheres, in others, the air is drawn through a tube of sugar and analyzed. These instruments have proven invaluable, also, in study ing the atmosphere in mines, quarries and industrial plants.

EVEN more remarkable is a recent series of experiments undertaken by the Bureau of Mines station at Pittsburgh, Pa., to determine the effects on workers of various atmospheric conditions. In cork-lined test chambers several hundred subjects have been put through strenuous exercises, while the experimenters are studying the effects produced on them by heat, cold, moisture, air movement, dust and dirt.

In other valuable experiments the same scientists are studying the possible use of ozone for the purification of air in schools, churches, theaters, offices, and other public places. Ozone, gone is effective in destroying harmful bacteria and disagreeable odors, they say, it may prove practically useful in reclaiming "secondhand air" so that it may be used over and over again without ill effects.

Perhaps the day is not far distant when vast ventilating and purifying systems will cleanse the air of entire cities, when huge vacuum cleaners will provide a dustless method of municipal housekeeping, when breathing smokestacks no longer will be needed and when men and women will work under atmospheric conditions best suited to their needs.

Don't Fall for "Bargain" Tubes

Continued from page 98

plate circuit would have prevented a burn-out. The short must have been to the filament lead that is not connected to the minus end of the B-battery.

The reason why the set of tubes we had now wouldn't bring in any music, he told us, was because they had gone dead. The active material on the filaments of gyp tubes is so thin that they rarely work for many hours beyond the test in the dealer's store. It is possible to make a tube that will show up fine on a test and still not have any lasting qualities.

The chances are that only one tube of the five I had had originally was bad. We paid out a dollar the first time and two and a half the second time, and now we had no tubes at all! That was the experience that converted me to the economy of paying more for tubes and of getting standard ones.

CONTENTS of This Issue

And More Than Two Hundred Other Articles and Pictures

You Have Asked Me—

Continued from page 3

avoided by having a greater thickness outside the flue lining, a least width of two bricks instead of one. But then the expense is greater, and there is still some heat loss. Furthermore, inside placement gives some wind protection to the chimney; and in cold regions the foundations of the chimney are safer inside.

Does a furnace always need a separate flue?

THERE are variations of this familiar question, as, for example, whether a pair of small flues used together will equal one large one. Heating engineers are quite insistent upon the separate flue, both because its capacity is figured to suit a given size of furnace and because an added intake makes cross currents or confusion of internal ascending gases which have different temperatures. A smooth and even flow of gases means a good draft, proper combustion of fuel and economy.

So it is best to follow the rule. In some cases a slight violation may not entail serious results, as when a small stovepipe or cook stove vent enters the furnace flue; but this is an exception or an experiment. A kitchen range that has coal capacity almost equal to that of the furnace should certainly not share the latter's draft. As for equalizing one large flue with two small ones, the principle applies to water pipes but cannot be transferred to the realm of combustion gases because of the temperature factor. The gases will cool in two flues and the furnace will not "draw" well.

What is the smallest desirable flue size?

ABOUT eight by eight inches, either round or rectangular, for a furnace. Eight by twelve inches is usual for an open fireplace. It is best to obtain correct sizes for a stated heating plant according to the manufacturers' tables. An ordinary fault is failure to bond the chimney projecting at least two feet above the ridge of the roof. This is a detail, but quite important as regards a good draft. Another fault is bonding or capping the top of the chimney which tends to reduce the free flow of gases.

Is there more than one way to frame a house so as to equalize shrinkage?

YES, there are many ways to apply the base principle, which is that wood shrinks across the grain or downward as in the case of a floor joist, while there is practically no shrinkage lengthwise or vertical with the grain as in a post or stud. The shrinkage factor must be allowed for in masonry houses with wood floors and partitions as well as in all-frame dwellings.

In order to visualize the problem clearly, let us disregard for the moment all upright or vertical members of the house. Let us see only the sill, the wood girder, the plates and the floor joists—or rather one floor joist at each level as representative of all. Add the depth in inches of sill, joists and plates; provided, however, that each is doing bearing duty or supports a vertical. The total shows the shrinkable element at the outside house wall. Add the similar figures at the center of the house. The two totals should be equal or made so.

To take an example: Suppose a sill bearing four inches deep; pass the negligible ribbon board at second floor but include four inches for attic floor plates of doubled two-by-fours. Thus there are only eight shrinkable inches at the outside. On the other hand, the inside shows a bearing depth of girder, ten inches; first floor joist, ten inches and ditto for the second floor joist. Total is thirty as against eight, and the house will settle very considerably in the center. To equalize, set the outside studs on top of subfloor above first floor joists, which in turn rest on sill; making a total of fourteen shrinkable inches. Set the inside studs down on girder and at the second floor down on plate—instead of standing on joists as before—and the inside figure becomes fourteen inches, equalizing the frame layout.

Can a wood girder be used when outer studs and joist ends rest on foundation wall with a so-called plank or box sill?

A METAL girder is better in that case, since it is hard to equalize the difference. Of course metal and masonry do not shrink appreciably. And the evening-up process should be applied as far as possible to each floor by itself. Otherwise, while the house may settle uniformly as a whole, there will be possible variations at the different floors.

What is bridging of joists?

BRACES between them in X style usually of two by three material spaced at uniform intervals of eight feet along joist length. They should be angle cut to make a good fit. A carpenter suggests that only one end of each bridging strip be nailed to its joist at first. Apply floor boards and then permanently nail bridging. This permits the joists to settle or accommodate themselves to the flooring.

Is it advisable to sheath the underside of a floor to prevent cold coming through?

USUALLY not, because damp air confined between joists may cause decay. Ventilation of woodwork near the ground is an important principle. Instead of sheathing beneath, put a layer of felt or heavy flooring paper on top and add a new top floor of oak or southern pine, preferably of edge or comb grain, also known as quarter and rift sawn. Such a floor will be warm and will wear well.

Mr. McMahon's services are available to our readers to assist them in solving their building problems. Letters will be answered free of charge. Address John R. McMahon, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.


This one
P70W-49K-LPSO

FORMER PLASTERER NOW MAKING $12,000 A YEAR

Worked for Small Salary

Henry J. Beilman had little education and little opportunity to get ahead, but he refused to give up. Deep within him was the longing to make something of his life before it was too late—to *build* a building some day instead of tinkering around it as a plasterer or bricklayer.

Resolves to Earn More Money

"If spare time study can help other men to get out of the rut," he said, "it can help me. I'm going to take up a course with the International Correspondence Schools and study at home. It's the only way I can ever hope to put myself on a par with technically trained men."

Gets Offer from Contractor

Beilman's friends laughed at him and said he was wasting his time, but he kept right on studying, for he could see how the course was helping him in his work. Soon one of the leading contractors heard about "this bright young man" and made him superintendent at a fine increase in salary.

Secures Big Contract

Beilman went ahead so rapidly that he decided to start a business of his own. He met with unusual success from the very start and today his income is "more than $12,000 a year." Recently he handled the contracting work of the new $800,000 Chamber of Commerce building in Scranton.

Glad He Studied at Home

"I give the International Correspondence Schools full credit for my success," Mr. Beilman writes. "There is nothing better for the man who has been deprived of the advantages of a college education. Many of my friends also give the I. C. S. full credit for their ability to do their work efficiently and well."

The Secret of His Success

Henry J. Beilman is a successful man today because he had vision—ambition—and perseverance. He realized that he had to learn more before he could earn more. Instead of just drifting along, he picked a definite goal and then worked and strived until he made his dreams come true.

The success of Henry J. Beilman is just another indication of the practical value of the home study courses of the International Correspondence Schools.

For thirty-five years these schools have been helping men to get ahead in business and in life and they will help you too if you will only make the start. All you need to do is this: Mark the work you like best in the coupon printed below and mail it to Scranton.

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☐ Mechanical Draftsman	☐ Metallurgy	☐ Architectural Draftsman	☐ Navigation
☐ Machine Shop Practice	☐ Steam Engineering	☐ Concrete Builder	☐ Agriculture and Poultry
☐ Railroad Positions	☐ Radio	☐ Structural Engineer	☐ Mathematics

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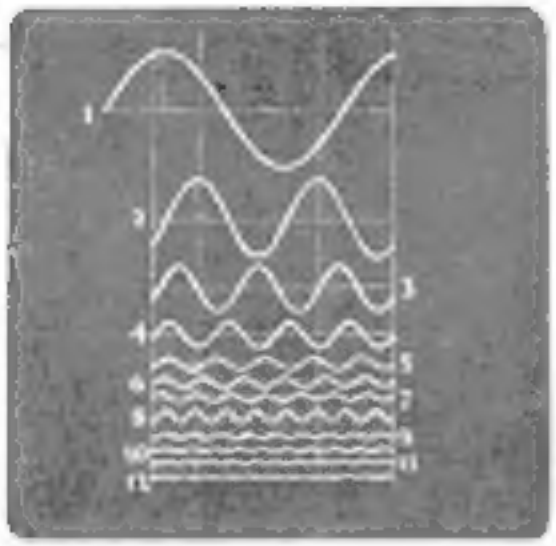
Name ..... Address .....

Canadian address—International Correspondence Schools Canadian, Limited, Montreal

And now Thomas A. Edison answers another questionnaire . . . . .



In the photographic diagram above, wave No. 1 is that of the fundamental tone of an organ-pipe. The numerous waves beneath it are that organ-pipe's overtones. They are as elusive as a ray of sunlight, yet their capture and preservation on a phonograph record is utterly essential to full, perfect Re-Creation of an artist's performance. It is obvious that they cannot be preserved if their microscopic strength is dissipated in any way — moving machinery, for example. But let ***Thomas A. Edison*** *give you his views on the subject.*

"I don't use delicate overtones to move machinery."

QUES. What is musical sound?

Ans. When anything such as a tightly stretched string connected to a sounding board is caused to vibrate rapidly and regularly back and forth it sets the air around it in rapid vibration which in turn vibrates our ear drums back and forth. Through the mechanism of the ear these vibrations are transmitted to our brains and we "hear" a musical sound. Physicists call such vibrations sound waves.

Ques. Sometimes music is rich, mellow and beautiful. Sometimes it is harsh, sharp and unpleasant. Why is this?

Ans. The presence or absence of overtones controls the beauty and quality of a musical sound. The more overtones there are, the richer and more beautiful the quality becomes. The difference between the metallic tinkle of a child's piano and the mellow resonance of a concert grand is due to overtones.

Ques. What are overtones?

Ans. When we set the string I mentioned vibrating it sends out a powerful or fundamental wave. It also sends out many other related waves. These secondary waves are called overtones.

A simple illustration of this: Drop a large pebble into a pool of quiet water; wave rings are formed that go out in all directions in smooth and regular procession over the surface of the water. Now try dropping the large pebble again but at the same time drop several very small ones along with it. The wave rings caused by the large pebble will be there as before but, in addition, there will be many little waves or ripples criss-crossing each other and the appearance of the principal waves will be quite different from what they were in the first experiment.

The big waves may be compared to the fundamental sound wave, and the little ripples that are superimposed on them to the overtones.

Another illustration might be an automobile crossing a series of mountain ridges. The mountains and valleys correspond to the principal or fundamental sound waves and the "thank-you-ma'ams" to the overtones—only in the case of music the "thank-you-ma'ams" are enjoyable.

Ques. What, in effect, do overtones accomplish?

Ans. I've already answered this in Question No. 2. To put it in another way, however, one artist with a few simple lines paints a picture; another paints the same picture but fills out his canvas with backgrounds of light and shade and with subtle color effects. It might be said that the second artist has added overtones to the sharp fundamentals of the first artist's work. The greater the skill in handling the overtones, the greater the master and the more permanently pleasing the effect. This is also true in music.

Ques. Can overtones be recorded on phonograph records?

Ans. Years ago I recognized the fact that only through capturing the delicate and elusive overtones as *well* as the fundamental wave, and faithfully recording them on a record, could phonograph music earn its right to a permanent place in the musical esteem of mankind. I have worked always with this goal in view. Nature has been reluctant, but one by one she has given up her secrets. The present Edison Phonograph is very close to my ideal.

Ques. How have you captured these delicate overtones?

Ans. In many ways. For example, I made a thicker record of greater solidity which would not shake and vibrate as a whole when played. I developed an extremely hard and smooth surface for the record so that the sound waves —the minute ones which are overtones— would not be flattened out when the diamond point passed over them. By adopting a permanent diamond point I got away from making the sound grooves "grind in" steel needles. By mechanically feeding the so-called tone arm across the record I eliminated having the delicate sound grooves *drag* the arm across. In other words, I don't use delicate overtones to move machinery. Countless experiments in recording have taught us many vastly important tricks and processes. No one thing has captured the overtones for us. I have mentioned a few but there are many others. A combination of many details working together has achieved present results. ★

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